ARMY ORDNANCE

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Pledged to Industrial Preparedness as Our Strongest Guaranty of Peace

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THE ARMY ORDNANCE ASSOCIATION

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THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guaranty of peace.

The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency, time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

The Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace insurance" in this form is the foremost aim of the Army Ordnance Association.

The Association is devoted solely to the national defense; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration. Membership, to which American male citizens are eligible, is four dollars a year. (Application on request.)

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guaranties of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers and manufacturers in civil life and the Regular and Reserve officers of the Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the industry of the nation and by the officers and civilian employees of the Ordnance Department in the wars in which the United States has been engaged.

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Our New Medium Tank

ARMY ORDNANCE

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The Battle of Production

Our National Effort for Military Armament

John D. Biggers*

TO THE general public, the word "ordnance" is probably a somewhat mysterious designation vaguely associated with guns—especially big guns. To us, the word "ordnance" is a very specific, real, and live thing because most of us are living and working and probably eating and sleeping ordnance seven days a week.

Ordnance means cannon, ammunition, bombs, tanks, rifles, machine guns—all of which are translated into the fire power of an army. Without fire power the largest and best trained military forces are completely helpless. If fire power is to be used effectively, it must be made available in strategic positions with the greatest possible speed, and the men who direct the fire power must be protected to the greatest possible degree. Therefore, the meaning and importance of ordnance to the safety of our nation is clear. Yes, and therefore our nation is tackling the job of producing it in vast quantities with the skill and energy that is characteristic of Americans faced with a tremendous challenge.

All of us know only too well the background of the effort in which we are now engaged. I do not have to describe those years following the World War when, in our admirable but tragic idealism, we tore down the costly and complex munition plants we had worked so hard to build during 1917 and 1918. I do not have to remind you of the years when we turned all our talents for production to the mass output of the implements of peaceful living. To the everlasting credit of the War and Navy Departments, our professional officers, although they often must have felt a sense of frustration, never ceased their planning—even when they had no funds with which to implement their plans. Carefully and conscientiously they began the tedious task of surveying, allocating, and awarding tentative orders to many of those who are hard at work on this program today. The country owes them a debt of gratitude for their persistence which finally bore fruit.

I KNOW that some were reluctant to accept educational orders because they could not see the necessity for them and because they were still fighting shy of the unpleasant connotation that had come to be associated in the public mind with makers of munitions. To these, too, the country owes a debt of gratitude because they did accept, in a spirit of true patriotism, those educational orders, the importance of which hardly can be overestimated today.

The days of educational orders are now past. We are beyond the point where we can leisurely acquire the "know how" of ordnance manufacture. While our friends of Europe and Asia are holding the ramparts of civilization under terrible punishment, we in this country are engaged in a desperate Battle of Production. There is no shooting or bloodletting in this battle, but, believe me, it is just as dramatic, just as crucial, as the actual clash of armed forces. This Battle of Production must be waged with all the courage and determination, with all the ceaseless vigilance, with all the skill and sweat and brain power of the Battle of Britain.

WE ALL know by now that a military fight cannot be waged successfully without total national effort. Neither can the Battle of Production. Every one must participate. Every one must play according to the rules. And the rules must be based on what is best for the national interest and not for special interest, or partisan interest, or sectional interest. National interest demands teamwork today as it never did before. As a nation, we have accomplished much, but the task is so tremendous and the urgency so great that one can never be satisfied. For example, caliber .30 machine guns are close to schedule; caliber .50 guns are right up to the notch—but in the former case, production must be increased 500 per cent by the end of the year and, in the latter case, nearly 1,000 per cent.

Small arms, such as rifles and submachine guns are, I am happy to say, running ahead of schedule; but here again the production of the one must be stepped up 100 per cent before the year ends and of the other, approximately 500 per cent. Small-arms ammunition has recently become a crucial item. America's production of important types has increased over 1,000 per cent during the past 9 months, but further great increases are demanded and must be achieved.

A number of vast explosive plants are under construction, and to date all have gone into production right on schedule—which is a great credit to the Ordnance Department and to the contractors, plant operators, and workers who made this achievement possible.

A word about tanks: The 13-ton light tank has been in substantial production for some months, and more than a hundred of them will be turned out this month (April). Even so, that rate of production must be doubled by the end of the year.

The story of the 26-ton medium tank is really an inspiring chapter in the history of the Ordnance Department. The Department had a medium tank in operation last summer—I rode in it. Its speed and maneuverability were marvelous. However, the experience in Flanders and France proved that modern warfare required much heavier armor and armament. This meant complete redesigning, for the increased weight, of course, required a heavier transmission and the strengthening of many other parts. The Ordnance

*Director, Production Division, Office of Production Management, Washington, D. C.

This is an address delivered before the Cincinnati Post, Army Ordnance Association, at the Queen City Club, Cincinnati, Ohio, April 12, 1941.

engineers, with the whole-hearted assistance of selected companies in industry, worked out this problem in record time with the result that a number of us went to the Aberdeen Proving Ground not long ago and saw this highly efficient new medium tank in operation—giving a great demonstration of speed, maneuverability, and fire power. This was the accomplishment of six short months from drafting table to finished product. During those same months, three great companies were at work tooling up and training men to make these tanks in quantity. They all promised to have their first models out this month (April) and will soon be in real production. Two other companies were added to the list subsequently, so eventually we shall have five good and widely dispersed companies manufacturing this tank.

The program is moving forward amazingly well, but we cannot be satisfied. It must move even faster. We have been going through the long and tedious period of designing, contracting, tooling up, training labor, and getting ready for the mass production of many of these very special and difficult items. America is the greatest mass producer in the world, but very few people realize that mass production inevitably takes a long time to get started. We are mass producers of peace-time products; it is a big shift to defense materials, and one that has required hundreds of new plants and hundreds of millions of dollars' worth of machine tools.

Let me stop here to pay a well-deserved tribute to the machine-tool industry of America. Cincinnati is the very heart of that all-important industry. More machine tools are made in Cincinnati than in any other city in the world. The industry's contribution—that of management and workers—has been, and is, almost miraculous.

This year the machine-tool output will exceed $700,000,000—more than 3 times the high peak attained during the World War years or in 1929. In October 1939, the industry was employing 1,400,000 man-hours weekly. By December 1940, employment had increased to 2,500,000 and, only 3 months later—by March 1941—it had been increased by almost another 1,000,000 man-hours to a present total of 3,441,000 man-hours weekly. In addition to increased shifts and hours of work, 72 firms have expanded their plants, 121 have added additional equipment, and 167 firms are subcontracting more than half a million man-hours weekly. This is a record of which the entire industry may well be proud.

However, production depends upon spirit and morale almost as much as it does upon machines. Experience has proved that an army cannot win with equipment alone—it must have spirit, determination, and unity. Therefore, I believe you will agree with me that our great problem is to get the American people to understand the fact that time is precious—to comprehend clearly the colossal magnitude and serious urgency of our nation's task. We should not waste a day or an hour—total national effort is demanded. I plead for that effort!

Editor's Note.—The Production Division, of which Mr. Biggers is director, was created as an operating unit of the Office of Production Management in Executive Order No. 8629, establishing the OPM, and its duties were defined in OPM Regulation No. 1 on March 7, 1941. The regulation specifies the functions of the division and the duties of the director in part as follows:

1. The director of the Division of Production, who shall be known as the Director of Production, shall execute and administer the authorities, duties, and responsibilities of the Office of Production Management pertaining to production.

2. The Director of Production shall have authority to propose action under section 9 of the Selective Training and Service Act of 1940, whenever in his opinion it shall be necessary or desirable to acquire materials, articles, or equipment, by action under said section 9; and all proposals for such action shall be made in the form of a recommendation to the Director of Priorities, who shall proceed thereon in accordance with paragraph 2 of Regulation No. 3.

3. To effectuate and carry out the authorities, duties, and responsibilities assigned to him herein, the Director of Production is hereby authorized:

(a) To establish such organization as the Director of Production may deem necessary to the adequate execution of the functions of the Division of Production, including the employment of personnel; (b) To execute and administer all the authorities, duties, and responsibilities of the Office of Production Management specified in said executive order, which relate to (1) the production of products and articles needed for defense with respect to which there is any problem of production or any shortage of available production facilities; (2) the sufficiency of the supply and production of, and the requirements (including government, export, and civilian) for, raw materials, industrial materials, heat, light, and power which enter into the production of products and articles needed for defense; (3) the development and expansion of facilities to produce such products and articles.

4. The Director of Production shall exercise the authorities, duties, and responsibilities assigned to him herein subject to the jurisdiction and control of the Director General acting in association with the Associate Director General; and he shall obtain their approval of the creation of the principal subdivisions within the Division of Production.

5. The Director of Production shall make such regular and special reports of his actions pursuant to this regulation as may be required by the Office of Production Management, and shall coöperate with the heads of other divisions, subdivisons, or agencies of the Office of Production Management, establish methods or procedures for handling any matters with respect to which the functions or activities of their respective divisions, subdivisions, or agencies may interrelate.

6. The Director of Production shall have authority to designate an assistant or deputy director to serve as Acting Director of Production in his absence or inability to act, subject to the approval of the Director General acting in association with the Associate Director General.

7. The Director of Production shall exercise his authority, duties, and responsibilities hereunder in coöperation with the Departments of War and Navy and other departments and agencies of the Government, and shall utilize their services and facilities to the maximum extent compatible with efficiency. He shall not assume responsibility for determination of the nature, kinds, types, specifications, or quantities of finished military and naval products and articles and facilities required by the Department of War or Navy, nor for the times at which they are required, the terms of orders and contracts therefor, the inspection thereof, the payment therefor, or the handling thereof after completion. He may, however, advise, make recommendations, and give assistance to the Departments of War and Navy with respect to all such matters. He may, where necessary, develop sources and methods of production for such products and articles and for the materials which enter into such production. . . .

Our New Medium Tank

A Fast, Heavily Armored Vehicle of Great Fire Power

Lieut. Col. J. K. Christmas*

THE medium tank is the backbone of our recently constituted Armored Force. The war in Europe has amply demonstrated the importance of this type of tank in armored or mechanized forces as well as the outstanding and decisive importance of modern mechanized fighting equipment in land operations as a whole. Owing to the publicity recently given to the initiation of quantity manufacture by private firms of the medium tank M3 in our country, it is considered that a short survey of the design and development of this new weapon will be of interest.

Prior to the outbreak of the war in Europe, the Ordnance Department had developed a medium tank (M2) of approximately eighteen tons' weight and had delivered a small number of these to the Infantry at Fort Benning, Ga., which was then charged with the operation of such tanks. An improved type of medium tank M2, known as the M2A1, was then developed. This type had a little heavier armor and weighed approximately twenty tons. A number of tanks of this type were manufactured by Rock Island Arsenal; some of these are now in the hands of troops, others are still under manufacture.

Early in 1939, a project was originated by the Ordnance Department to mount in the medium tank M2 a 75-mm. howitzer in addition to the turret-mounted high-velocity 37-mm. gun and caliber .30 machine guns used in the medium tanks of the M2 series. The object of mounting the 75-mm. howitzer was to add to the tank a weapon capable of firing high-explosive shell, shrapnel, and smoke shell, in order that the medium tank might furnish direct light artillery support for tank and other mechanized units and in order that the medium tanks might take full advantage of the many outstanding qualities of light artillery fire, not only against personnel but against many classes of unarmored material targets.

This project was completed in the winter of 1939 at Aberdeen Proving Ground, Md. The tests, both at the proving ground and by the Infantry Board at Fort Benning, were so successful that recommendations were submitted by the proving ground in the early part of 1940 that *all* medium tanks to be manufactured or completed thereafter should be fitted with a 75-mm. weapon, mounted for fire generally to the front, in addition to the 37-mm. high-velocity armor-piercing gun mounted in the turret for all-around fire. This project was not immediately acted upon. However, when the Congress in the spring and summer of 1940 made available funds for the manufacture of a large additional quantity of medium tanks, and when the lessons of the war in Europe were more and more being brought to our attention, the importance of this project soon was realized together with the great importance of tanks generally. Valuable information and advice were obtained particularly from Great Britain, birthplace of the tank in 1915. It was decided to apply the principle of mounting a cannon of 75-mm. caliber to any new medium tanks to be manufactured.

IN the summer of 1940, the War Department reorganized our mechanized cavalry and our infantry tank units into an Armored Force, with the result that the tactics and equipment requirements of our mechanized units were placed in somewhat different hands, and some new desired tactical characteristics were added to the armored fighting vehicles to be used by the Armored Force. The fighting tank had somewhat belatedly come of age and at last had been recognized in the military family!

For a number of years, the Ordnance Department had been working with the very limited funds and personnel available to it (and with the somewhat limited interest which industry then actually had in its work) on various projects looking to the improvement of our tanks generally.

The greatly increased funds, the increased personnel, and, last but not least, the greatly increased interest and support of industry made it possible in the summer of 1940 to implement various ideas for tank improvement and to include them in the new lot of medium tanks to be manufactured for our Armored Force. Simultaneously with the decision to redesign completely our medium tank before going into production, it was decided by the Chief of Ordnance to have this redesign made at the Aberdeen Proving Ground, particularly because the great variety of armored fighting vehicles under test there and the varied experienced personnel there available would contribute greatly to the success of the design. Moreover, the personnel, shop and test facilities available at the proving ground would make possible a very quick, informal, and closely coördinated design and development which would insure particularly speedy action and also make it practicable for the various components of the design to be fully tested before final incorporation into the working drawings.

The design of the medium tank M3 was started in September 1940 and completed the first day of March 1941. Experienced tank drafting personnel were lent to Aberdeen Proving Ground from Rock Island Arsenal for this redesign.

*Aberdeen Proving Ground, Md. Lieutenant Colonel, Ordnance Department, U. S. Army.

The 75-mm. Cannon Makes the New Medium Tank M3 a Formidable Weapon

In the design and development of the medium tank M3 at Aberdeen, the following procedure was, in general, employed: General layouts first were made of the major components and assemblies involved. These layouts then were roughly reduced to full-scale wooden models, which usually led to some revision of the design in the interest of better functioning, strength, or convenience in use. As a result of study of the preliminary wooden mock-ups, the layouts were revised and a more careful and more detailed full-scale wooden mock-up or model again made, this time for greater attention to details.

From the revised layouts, detailed working drawings were made, and from these drawings full-scale actual metal components were manufactured, just as required in the production tank, and were fully tested to determine that they were satisfactory in every way. When this test had been made, the detailed working drawings were given a final check and issued to the various manufacturers. In order to expedite the work, the manufacturers (that is, the prime contractors who were to manufacture the medium tank) were furnished preliminary prints so that they might plan their shops, order the necessary machine tools and materials, and in general set up their manufacturing facilities.

During the process of development, the various prime tank manufacturers, as well as the manufacturers of the principal components, commercial units, and accessories, had engineers almost constantly at the proving ground. This practice had the advantage of acquainting the manufacturers with what they were required to make and of acquainting the Ordnance Department with the very latest in manufacturing processes, in engineering development, and in commercial components available for incorporation in the new tank. The advice of experts was thus obtained on the hundreds of special engineering problems involved in the manufacture of this tank.

It should be understood that the design of an armored fighting vehicle, such as the medium tank M3, can in no case be called the work of one man, or even of a few men. Like the airplane or the naval vessel, the fighting tank incorporates within itself a very large proportion of the best technical advancements available in science and industry. Our automotive, steel, rubber, and electrical industries all have contributed to its development. Valuable assistance also was obtained from those activities of the Ordnance Department concerned with fire-control instruments and cannon. Close coöperation was maintained with the Signal Corps with respect to radio equipment and with the Armored Force which is to use the tank for the serious business of defending America. Coöperation with the latter was carried on particularly through a resident representative of the Armored Force at Aberdeen.

Some idea of the work involved in developing and designing this new medium tank may be gathered from the fact that a tank in its entirety contains approximately 25,000 separate parts, covered by some nearly 6,000 drawings. Some of these drawings are of commercial origin as in the case of the instruments, engine, generator, and batteries. Due to the number of contractors, subcontractors, and agencies of the Ordnance Department involved in the manufacture of this tank, it was necessary to distribute from Aberdeen Proving Ground between October 1940 and March 1941 some 75,000 prints, as well as thousands of letters and specifications concerning design and manufacture. Formal and close coöperation among all concerned was further maintained by fre-

THE M3 ALSO MOUNTS A 37-MM. GUN AND TWO MACHINE GUNS IN ITS TURRET AND CUPOLA

quent meetings of our Tank Committee, usually at Aberdeen. At these meetings, the drawings and model components were explained and discussed fully and frankly. On this committee were represented the Office of the Chief of Ordnance, Aberdeen Proving Ground, the tank manufacturers, the principal subcontractors, and the Ordnance districts responsible for inspection.

THE pilot medium tank M3 was built as follows: Rock Island Arsenal manufactured what may be referred to as the chassis; that is, the tank less the turret assembly. The cannon were manufactured at Watervliet Arsenal, the sights at Frankford Arsenal, and the turret assembly at Aberdeen Proving Ground. The pilot was completed in March and was formally demonstrated in maneuvers and firing before the Chief of Ordnance, officials from his office, from the Office of Production Management, and representatives of the tank manufacturers and subcontractors at Aberdeen Proving Ground on April 4, 1941.

A few weeks later, the American Locomotive Company, the Baldwin Locomotive Company, and the Chrysler Corporation each formally delivered to the Chief of Ordnance or his representatives the first production models of the medium tank M3, thereby initiating the quantity production of this important vehicle which is the backbone of our Armored Force. It may be fairly said here that while this tank incorporates to the fullest extent the latest lessons learned from the war in Europe, it is fully an American concept and an American accomplishment. It is a relatively high-speed, maneuverable tank with great fire power, fitting the American policy of aggressive mobile warfare. It represents, I believe, the best integrated experience, ability, and intelligence of American industry and the American Army. By dint of hard, high-pressure, expedited work, this tank was designed and developed in a remarkably short time and put into production in a total period well under a year—and some six months earlier than estimated. This redesign was justified both because our limited funds during the years of peace had not allowed us to develop ideas which we knew should be in a tank and also because the war in Europe had brought out new ideas and had greatly reënforced the ideas of mechanization. No time was lost in getting tanks into production, for the tank manufacturers in the interim were getting their plants ready.

The war in Europe has at long last made the tank respectable in good military society. The fighting tank has come of age and taken its proper place alongside the airplane and the naval vessel. The medium tank project, representing hundreds of millions of dollars in monetary value and much more in national-defense value, is now in full swing. It is producing a machine which we believe is good because it is of America, by America, for America.

EDITOR'S NOTE.—Colonel Christmas, long an exponent of Army mechanization and motorization and an expert on the fighting tank, has contributed numerous articles to ARMY ORDNANCE on these subjects. Among his principal writings in ARMY ORDNANCE are the following: "Tanks" (Vol. XXI, No. 124, p. 363); "Manufacture of High-Speed Tanks" (Vol. XIX, No. 112, p. 214); "Mechanized Forces" (Vol. XVI, No. 91, p. 22 and Vol. XV, No. 90, p. 327); "Mechanization in Our Army Today" (Vol. XIII, No. 73, p. 11); "Is Mechanization Expensive?" (Vol. XI, No. 61, p. 22); "Mobility of New 3-Inch Antiaircraft Guns" (Vol. IX, No. 54, p. 395).

Mr. John C. Garand
The Rice Medal

Col. Herbert W. Alden
The Scott Medal

Col. James L. Walsh
The Crozier Medal

Army Ordnance Medalists, 1941

Honors for Distinguished Service

CANDIDATES to receive the newly founded Army Ordnance medals, described in the last issue of this journal, are announced by the Committee on Awards as follows:

John C. Garand, of Springfield Armory, Mass., inventor of the U. S. Army Semiautomatic Rifle M1, is awarded the Brig. Gen. John H. Rice Gold Medal for Meritorious Service in Armament Engineering.

Col. Herbert W. Alden, of Detroit, Mich., chairman of the S.A.E. Ordnance Automotive Advisory Committee, is awarded the Col. Frank A. Scott Gold Medal for Meritorious Service to Industrial Preparedness.

Col. James L. Walsh, of New York, N. Y., founder and first editor of Army Ordnance, is awarded the Gen. William Crozier Gold Medal for Meritorious Service to the Army Ordnance Association.

The Committee on Awards which chose the candidates to receive the Army Ordnance medals for 1941 consisted of Col. William W. Coleman, of Milwaukee, Wis., first vice-president of the Association; Earl B. Gilmore, of Los Angeles, Calif., president of the Los Angeles Post, and August H. Tuechter, of Cincinnati, Ohio, president of the Cincinnati Post. The awards will be made at appropriate ceremonies during the fall, the time and place of each to be announced in due course.

MR. GARAND was born at St. Remi, Province of Quebec, Canada, and at the age of eleven went with his parents to Danielson, Conn. His formal education ended at the age of twelve when he began his first work in a cotton and thread mill at Jewett City, Conn. Soon after entering upon this work he invented a machine which painted the tips of bobbins, thereby eliminating a hand operation. Under the guidance of his foreman, Joseph Labonne, young Garand "learned by doing." He performed a variety of mechanical work for the mill with such proclivity that he quickly attracted the attention of his superiors and was transferred to the machine shop where he remained until he was 19 years of age. In 1907, he entered the employ of a welding company in Providence, R.I. Gas welding with oxyacetylene torches was then in its first stages of development. In 1909, he entered the employ of the Brown & Sharpe Company at Providence where he was employed in tool making and the design and construction of gages and special appliances for screw machines.

In 1916, Mr. Garand, working as a tool maker in New York, turned his attention to the design of semiautomatic rifles. He submitted a design for a light machine gun to the United States Navy. This so attracted the attention of the authorities that he was requested to come to Washington and continue his researches at the U. S. Bureau of Standards. Here he remained eighteen months until, in 1919, he was transferred to the Springfield Armory, Springfield, Mass., to begin his work as an Ordnance engineer at that historic arms center. There he developed the semiautomatic shoulder rifle which bears his name. Adopted as the standard shoulder rifle by the U. S. Army, the Garand has proved itself to be a weapon of superior fire power well adapted to the needs of modern combat. Recently the Garand was adopted also by the U. S. Marine Corps.

The long and arduous road to this successful goal entered its last stage November 7, 1929, when the construction of the first caliber .30 Garand semiautomatic rifle was authorized. This model was tested at the Aberdeen Proving Ground in October 1931. Subsequent modifications and tests lasted until

1935. Final changes, revisions, and tests were satisfactorily completed in December of that year. In January 1936, the rifle was officially standardized as the U. S. Rifle, Caliber .30 M1. The first delivery of production weapons started at Springfield Armory during September 1937, at the rate of 10 rifles a day; by January 1940, the rate was 200 a day.

Now in his fifty-third year, Mr. Garand spares no energy in advancing production of his famous rifle at the armory. By latest report, production of the semiautomatic rifle has increased 360 per cent in the past year.

The Army Ordnance Association acclaims this inventor for his ability, ingenuity and perseverence in developing against severe competition a semiautomatic rifle for the American Army. The Association honors him with its medal bearing the name of another distinguished Ordnance engineer, the late Brig. Gen. John H. Rice, who himself had an important part in the early steps toward the adoption of a semiautomatic shoulder piece shortly after the World War.

COLONEL ALDEN has long been identified with the automotive industry in the United States. He has taken a leading part not only in the development of automotive vehicles for peace-time uses but has given unstintingly of his ability and effort in the design and production of military equipment. He was a member of the organizing committee which founded the Army Ordnance Association in 1919.

Born in Lyndonville, Vt., he was graduated from the Massachusetts Institute of Technology in 1893. His first experience as a mechanical engineer began in that year when he entered the employ of the American Projectile Company, then engaged in work for the Army and Navy. With two associates, he designed, built, and tested a gasoline-engined tricycle which was first run in November 1894. The following year he joined the Pope Manufacturing Company, Hartford, Conn., as assistant engineer in the company's newly formed motor-car department. There he remained until he became chief engineer of the Timken Roller Bearing Axle Company of Canton, Ohio, in 1906. With others, he organized the Timken-Detroit Axle Company in 1909, becoming chief engineer. He was vice-president of the company until 1922, chairman of the board, 1922-1940, and is now director of engineering.

Colonel Alden's service with the Ordnance Department of the Army began in 1917 when, as a major, he was assigned to engineering work on tanks, tractors, and trailers. He was sent to England and France to study tank warfare and to help organize the Anglo-American Tank Commission, on which body he was the American engineering representative. In collaboration with Col. G. A. Green, he designed the renowned Inter-Allied Mark VIII tank. For his patriotic and effective World War service he was awarded the Distinguished Service Medal.

He returned to civil life in 1919, having attained the rank of lieutenant colonel. In 1931 he was advanced to the rank of colonel of the Ordnance Reserve. He is a founder member of the Society of Automotive Engineers (1905) of which organization he was president in 1912 and again in 1923. Except for two years since 1920, he has served continuously as chairman of the S.A.E. Ordnance Advisory Committee. Last year he became a member of the S.A.E. National Defense Committee. He is an engineer consultant to the Chief of Ordnance and renders yeoman service in the new designs of automotive fighting equipment.

The Army Ordnance Association acclaims this leader among automotive engineers for his service to the national defense. Of sound judgment, wide experience, and acknowledged engineering skill, Colonel Alden typifies the best traditions of the patriotic citizen in his allegiance to the national defense. His service to industry and the Army ever has been distinguished by the absence of self-interest and the desire to give of the best of his talents to the betterment of military equipment for the defense of his fellow citizens. The Association honors Colonel Alden with its medal bearing the name of Col. Frank A. Scott, whose contributions in the field of industrial preparedness for the welfare of his country have brought about conditions under which engineering for national defense at last is given its proper valuation and appreciation.

COLONEL WALSH founded ARMY ORDNANCE, the first issue of which was published July 1, 1920. It was the first technical and scientific magazine in any language in any country to be devoted exclusively to the advancement of industrial preparedness for national defense. It has been called by no less an authority than the renowned Maj. Gen. C. C. Williams, Chief of Ordnance 1918-1930, "A new weapon for our national defense."

As first secretary of the newly formed Army Ordnance Association (1919), Colonel Walsh undertook, single-handedly and with characteristic enthusiasm, the publication of a military-industrial magazine which was to serve as a medium for the Association's viewpoint in presenting the technical, scientific, and educational aspects of military armament design, production, and supply. That he planned well is demonstrated by the position ARMY ORDNANCE now holds in its field.

A native of Massachusetts, Colonel Walsh was graduated from the United States Military Academy, a member of the class of 1909. He served in the Ordnance Department in positions of high responsibility in peace and war until his retirement from the Army in 1922. His World War assignments included service overseas and later as executive officer to two Chiefs of Ordnance, Maj. Gen. William Crozier and Maj. Gen. C. C. Williams.

When he left active military service in 1922 he became connected with the Bankers Trust Company of New York where he served as assistant vice-president, and vice-president and director of the McGraw-Hill Publishing Company. He later became vice-president of the National Bank of Detroit. An official of several engineering and research organizations, he is now chairman of the National Defense Committee, American Society of Mechanical Engineers, and is leading the forces of that great engineering organization in its defense activities. He was awarded the Distinguished Service Medal for his World War service. He also wears the Victory Medal, Mexican Border Service Medal, Mexican Medal (U.S.), Commander Saints Maurice and Lazarus (Italy).

The Army Ordnance Association acclaims the founder and first editor of its journal, ARMY ORDNANCE, for his foresight, perseverance and continued loyaltv to it and its ideals through many years. Untiring in his efforts to advance the Ordnance cause, ever zealous in his willingness to help the matériel progress of the United States Army, it is particularly appropriate that Colonel Walsh be the first recipient of the Association's medal bearing the name of his former chief, General Crozier, himself a prime mover and willing sponsor of the Army Ordnance Association since its foundation twenty-two years ago.

Ordnance in the New Army

The Field Units for Maintenance and Supply

ON the chart facing this page is shown the tactical organization of the field forces of the United States Army in the continental United States. It is a new, fast-moving, hard-hitting strong military machine. The chart is prepared with particular reference to the Ordnance units of seven different types which are shown with their numerical designations and assignments for armament supply and maintenance. Thus, the vast Ordnance responsibility for a mechanized army is indicated visually.

The field forces of the Army of the United States now consist of General Headquarters (GHQ), four field armies, GHQ aviation, the Armored Force, and a GHQ reserve. This constitutes the tactical organization which is concerned with the training of an efficient field force and its possible use in war. This is in contrast to the administrative organization exercised through the corps-area commanders which is concerned with the procurement of man power, the basic training of newly procured men, the administration of military posts and stations, and other responsibilities.

The Chief of Staff of the Army, in addition to his duties as such, in peace is assigned by the President to command the field armies. In the event of war, he continues to exercise command until the President designates another commander. General Headquarters (GHQ) is the headquarters of the field force. There is but one GHQ, regardless of the number or location of theaters of operation. A General Headquarters of the Field Forces, Army of the United States, was established at the Army War College, Washington, D. C., on July 26, 1940, by order of the Secretary of War. It consisted, initially, of a chief of staff, a general-staff group, and an administrative staff group. It functions under the direction of the Chief of Staff of the Army as the principal officer of the Army. It is concerned with the training of tactical units. In the event of war, the Chief of Staff of the Army would become at once the commanding general of the field forces and assume active charge of military operations. The establishment of a functioning general headquarters provides him with the nucleus of a staff which is organized, trained, and ready to establish itself wherever circumstances may require.

The term "GHQ" is not a new one for the Army of the United States. On May 18, 1917, at Chaumont, France, General Pershing established his general headquarters. It was discontinued in August 1920. During the interlude 1920-1940, the Chief of Staff of the Army exercised administrative as well as tactical control of the various activities of the military establishment through the agencies of the War Department and the corps-area and department commanders. While this arrangement has advantages during a period of peace and harmonious international relationships, it is quite obviously unsuited to war conditions. Under the present arrangement, the movement of the field forces should cause only minor readjustments in the vital administrative requirements of procurement of man power, basic training, and supply.

A *field army* is composed of a headquarters, certain organic army troops, and a variable number of divisions; these divisions together with certain auxiliary units, called corps troops, are organized into army corps, each with a corps headquarters. Several armies, together with certain GHQ troops and aviation, may be organized into a group of armies under a designated commander. The commander of a field army holds the rank of lieutenant general. The field army, the army corps, and the division, are classified as "large" units. Four field armies have been formed.

An *army corps* is a tactical unit and consists of a corps headquarters, certain auxiliary units, called corps troops, and a variable number of divisions. The Armored Corps operates directly under General Headquarters and is not a component of a field army. There is no unit of the Air Corps which can be considered as corresponding in organization to the army corps. The location of the headquarters of a field army, army corps, or division is subject to change, since these are units of the field forces in no way connected with the territorial administration of corps areas.

A *division* is the basic large unit of the combined arms. It comprises a headquarters and troops of the essential armed services, all in correct proportion and so organized as to make it tactically and administratively a self-contained force capable, to a limited extent, of independent action.

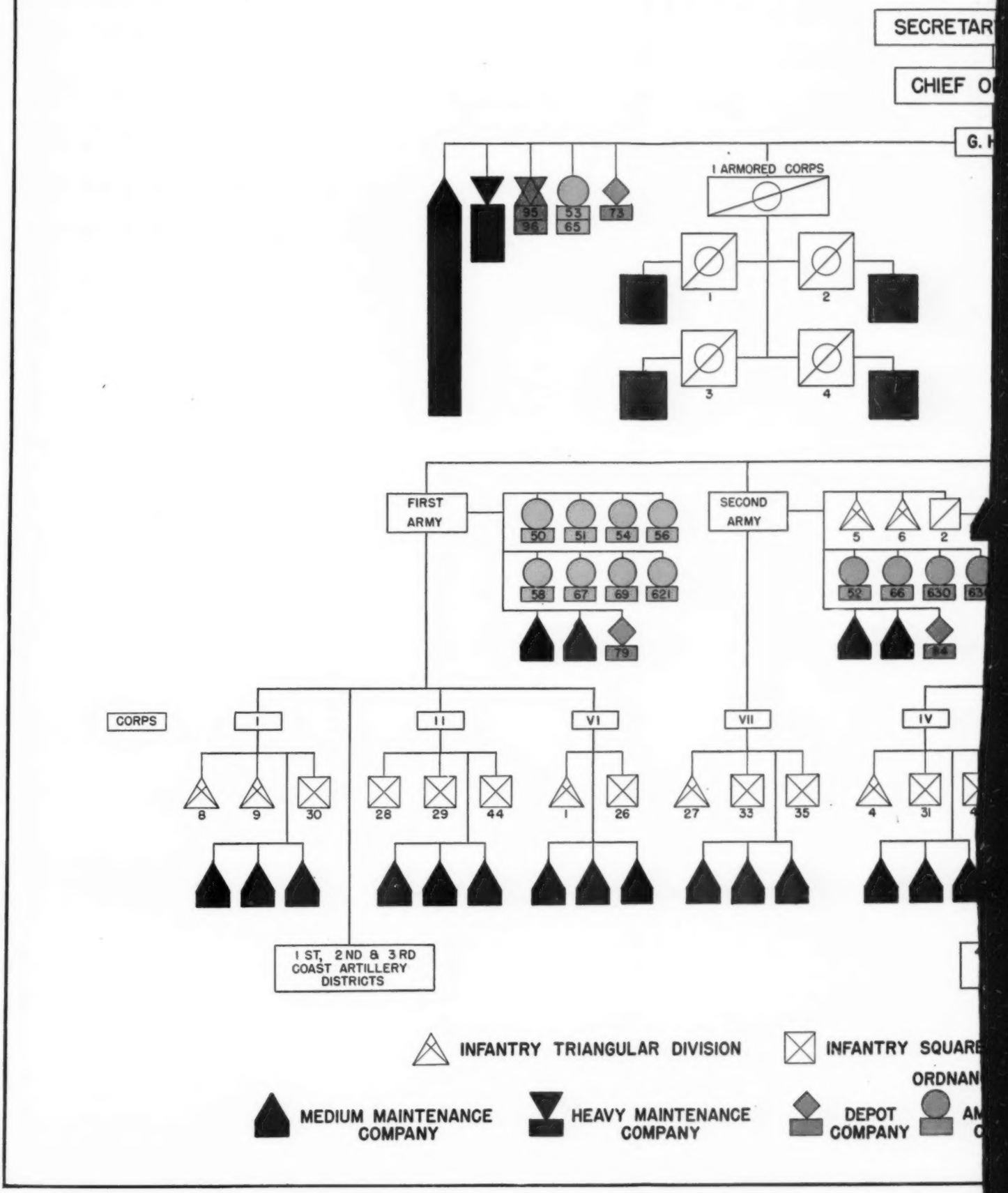
THERE are three kinds of divisional organization: the infantry divisions, the cavalry divisions, and the armored divisions. Infantry divisions have three different forms: the infantry division, "square," as used by the National Guard and by Regular Army divisions in foreign service; the infantry division, "triangular," as used by Regular Army units in the field forces; and the infantry division, "triangular," motorized. There is no organization within the Air Corps which is completely analogous to the division.

The commander of a division is a major general. He is provided with a personal staff, a general staff, and a special or administrative staff. The division is the smallest military unit to include a general staff. Each of the several types or kinds of divisions may be considered as consisting of a command element, combat or fighting elements, and service elements. Regular Army divisions are numbered from 1 to 25, inclusive; National Guard divisions from 26 to 75; and divisions of Organized Reserve units from 76 and higher.

The Ordnance field organization, as it relates to the tactical army, with its various types of units distinguished by a particular legend and color, is shown on the chart facing this page. The numerals shown are the designations of the various units. A detailed description of the functions of the several types of Ordnance units was published in an article entitled "Ordnance Service in Our New Army" by Brig. Gen. James K. Crain, Chief of Field Service, Ordnance Department, in the March-April 1941 issue of ARMY ORDNANCE (Vol. XXI, No. 125, p. 466). In the May-June 1941 issue (Vol. XXI, No. 126, p. 630) was published a complete list and chart in color showing the various Ordnance Field Service organizations with their assignments and stations. General Crain's article, the previous chart, and the one opposite, will give a composite and current picture of the Ordnance Field Service organization as it exists today.

Tactical Organization of the Army—A New Fas

Showing the Ordnance Units, by Type, Numerical Designation, and



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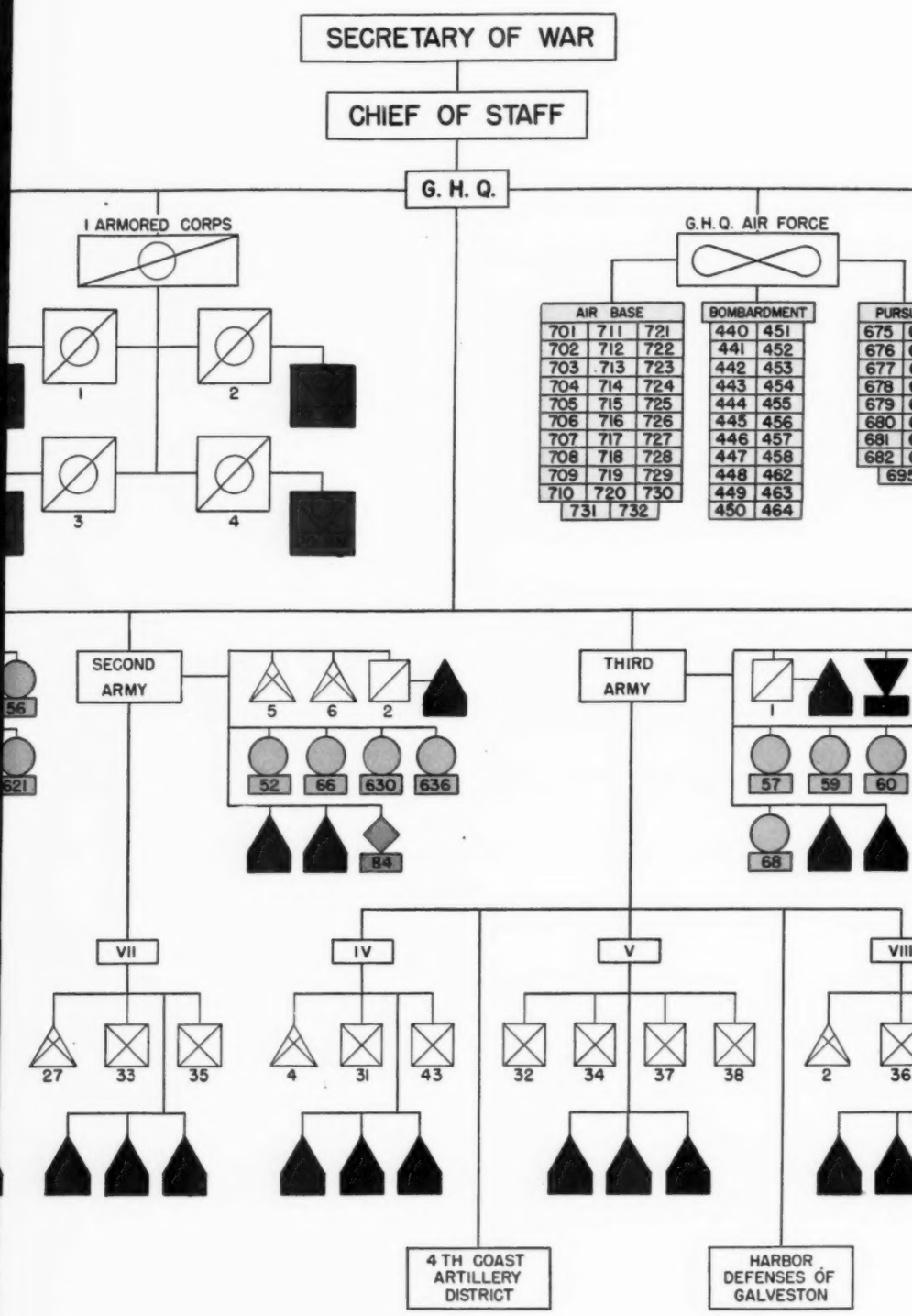

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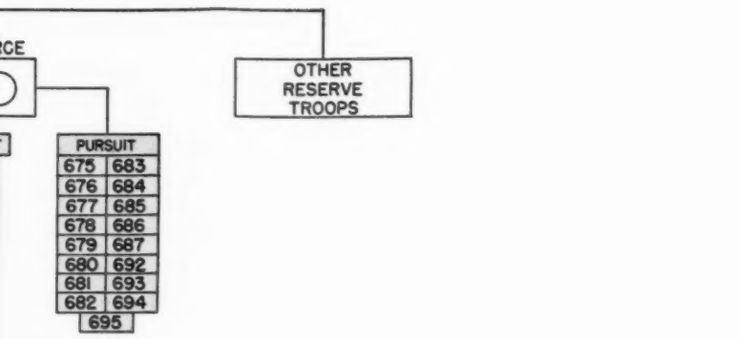

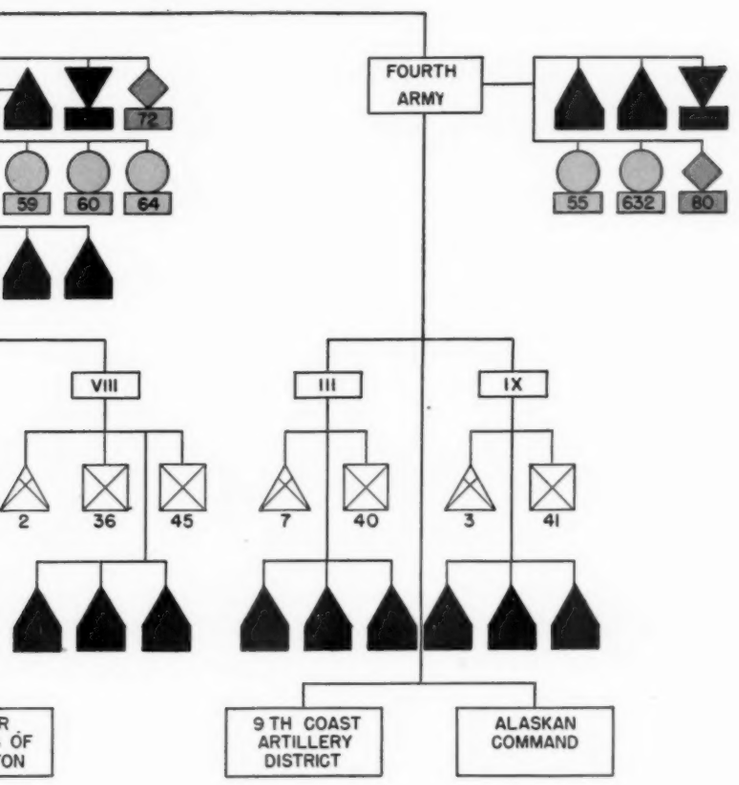

ARMORED DIVISION

AVIATION COMPANY

MAINTENANCE BATTALION

Armament Engineering

The Ordnance Research and Advisory Committees

Brig. Gen. G. M. Barnes*

DURING the period from 1920 until 1938 the average appropriation for the Ordnance Department was approximately $12,000,000 a year. These funds were used principally for maintaining six manufacturing arsenals, the Army proving ground, for research and development work, and for the manufacture of a small quantity of ordnance matériel annually. In 1938, the appropriation was increased to $50,000,000 for the purchase of modern equipment for our Army, and in 1939 a still greater appropriation of $130,000,000 was made by the Congress for this purpose.

The first large emergency appropriation for the Ordnance Department became available in September 1940. It called for the expenditure of $2,000,000,000 for ordnance equipment. Some six weeks later, letters of intent or contracts covering this amount had been placed with American industry. In view of the fact that ordnance is noncommercial equipment, this represented an outstanding achievement. No commercial concern in the United States has ever been called upon to do this amount of business in so short a time.

This great increase in activity developed almost overnight, and were it not for the farsighted plans made some twenty years ago and kept current since, the rapid procurement of this equipment would have proved a hopeless job. Fortunately, the Ordnance Department had foreseen such a possibility and had subdivided the country into fourteen Ordnance procurement districts, thus decentralizing the task. These district offices had been functioning in a limited way for some eighteen years and had made studies of the industrial facilities in their districts, determining which facilities were most capable of manufacturing the different types of equipment and listing the machine tools of the various plants. Industrialists had coöperated fully with the Department and had spent considerable sums in studying ordnance drawings and specifications—no funds then having been appropriated by the Congress for this purpose.

When authority was obtained from the Congress to negotiate orders in September 1940, it was possible for the Department to base its contracts upon the allocations of these facilities which already had been made by the districts. Consequently, the Department was able to negotiate quickly the orders for this great quantity of matériel and to place the contracts with those concerns most capable of producing the various items. Ordnance equipment covers a wide field, totaling some 1,200 major items and approximately 250,000 important components. Such equipment is of a specialized nature and has been designed to meet the requirements of the various combat arms—the Infantry, Cavalry, Field Artillery, Air Corps, Armored Force, and Coast Artillery Corps.

Luckily for national defense, the small sums of money made available by Congress for the Ordnance Department over the past twenty years were sufficient to permit continuous work on the research and development of the weapons required by the combat arms. Consequently, when the present emergency arose, drawings and specifications of all the various types of equipment required by a modern army had been completed, with minor exceptions.

Pilot models of semiautomatic shoulder rifles, automatic cannon, scout cars, tanks, field guns, antiaircraft guns, fire-control instruments, and similar items had been developed, built in limited quantities, and tested by the using services. The Ordnance Department never adopts an item of equipment for manufacture until each weapon has been tested and until the using service has found the weapon superior to the one already in use. Normally, it takes four or five years or more of constant effort to perfect a new weapon, although occasionally, under special circumstances, this time has been reduced to one or two years. After standardization, a weapon may be considered modern for ten to fifteen years. This general statement, however, does not always hold true, for in cases of special weapons, such as tanks, progress may be so rapid as to render a new model obsolete within a year.

THROUGHOUT this 20-year period, military attachés and special Ordnance representatives abroad had been studying foreign equipment to insure that our new matériel did not lag behind foreign weapons. Today we know from tests of foreign equipment at our proving ground and from reports of our representatives stationed throughout Europe that the ordnance equipment which we have asked manufacturers to produce in quantity represents new and up-to-date matériel which is not exceeded in quality by that in use abroad.

It was obvious that the hundreds of American manufacturers of ordnance equipment would encounter many difficulties in the manufacture of these weapons strange to industry. From our experiences in the World War, we realized also that many engineering questions would arise concerning drawings and specifications. It was known that these drawings and specifications were not perfect. It was to be expected that out of the hundreds of items to be produced and the hundreds of thousands of drawings issued to manufacturers many questions would arise concerning metal specifications, tolerances, methods of manufacture, and reasons for making the component parts one way or another.

Hence it was deemed advantageous that organizations should be formed before which these problems could be discussed and decisions rendered on controversial points. After a study of this situation, it was decided to organize engineering advisory committees, and to ask the manufacturers to designate one or more engineers to serve as their representatives. These engineers from industry would meet with qualified Ordnance officers and Ordnance engineers to discuss the difficulties which had arisen in their work. With these objectives mainly in view, invitations were sent to companies having prime contracts for ordnance matériel.

It was found that the field of ordnance equipment could be covered through the organization of twenty-five advisory committees. All manufacturers of tanks were organized into a Tank Committee; all manufacturers of mobile artillery carriages were organized into a Mobile Artillery Carriage Committee; all manufacturers of bomb fuzes of various types

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were organized into a Bomb Fuze Committee, and so on through the list.

The response of American industry to our invitation to form committees and to send their representatives to the meetings to be held in Washington at various arsenals or wherever the committees might decide, has been spontaneous and complete. These committees now have been functioning three or four months and it is the purpose of this article to report some of the results which have been obtained through this coöperative effort between the Ordnance Department and American industry.

AT THE first meeting of each committee, the manufacturers' representatives were asked to vote as to whether their companies would wish to have the committee formed on a permanent basis. In every case, opinion has been unanimous in favor of the committees. The members were next asked to select a chairman by vote from their own membership, for it was considered that the manufacturers would prefer to have their committees presided over by chairmen of their own choosing. An officer of the Ordnance Department was designated as permanent secretary for each committee to conduct any necessary correspondence and to write and distribute the minutes of the meeting. A permanent record of the action taken at each meeting has been made and the minutes distributed to all members. A statement of the activities of a few of the committees may give an idea of the results achieved.

The Tank Committee has been a very active one. This has been due to the fact that it was necessary for the Ordnance Department to redesign its medium tank just prior to placing it in quantity production, incorporating in it the important changes resulting from battle experience abroad. It was deemed necessary to increase the thickness of armor and the power of the tank's armament. The tank manufacturers have been very active in assisting in this redesign, sending draftsmen and engineers to work coöperatively with our engineers. At each meeting of the Tank Committee, questions concerning changes recommended by the members have been discussed and many of these suggestions have been incorporated in the design. The ordnance drawings were sent out progressively, as the work of redesign progressed.

In this way, several months were saved over the method which would have required the manufacturers to wait until all the drawings were completed before undertaking production. At the same time, the suggestions and criticisms of the manufacturers have been obtained almost from day to day and have been taken advantage of prior to tooling for quantity production.

Another important feature of the committee's work has been that while one manufacturer may suggest a change in the design which would seem to be beneficial to him, it has been found that other manufacturers would be decidedly against any such change. These questions have been debated in the committees and the best compromise made to meet the general situation. In many cases a difficulty which has presented itself to one manufacturer already has been solved by another, and all manufacturers have been able to benefit through this exchange of ideas.

ANOTHER important result of the committee meetings has been the interchange of information concerning sources of material. Subcommittees have been formulated to aid in the procurement of special parts or material or parts used in small quantities. The requirements of each manufacturer may not be of sufficient quantity to justify the necessary special processing, but by combining their limited needs for these items a large enough volume was obtained to prove of interest to a reputable source of supply. This also resulted in a substantial saving in cost. A gage subcommittee was organized to coördinate the various manufacturers in regard to inspection gages. This information has been valuable to manufacturers as a guide in the design and production of manufacturing gages. The tank-gage program now is well coördinated among the contractors for medium tanks.

At the meetings of the Small-Arms Weapons Committee, many important engineering questions have been discussed in detail, such as steel specifications, finish on parts, and the broaching of rifle barrels. Considerable work has been done at Rock Island Arsenal in the broaching of barrels, and this information has been submitted to all manufacturers of small-arms weapons. The development of a method of welding the two end-caps to the water jacket of the caliber .50 water-cooled machine gun was discussed at a committee meeting, and, as a result, this process now is being actively investigated and tested. A subcommittee has been formed for possible modifications of machine guns to enable improved manufacturing processes to be undertaken.

The Antiaircraft Carriage Committee reported that some difficulty was encountered by manufacturers in obtaining steels under War Department specifications and designations. These difficulties have been studied and in most instances arrangements were made to provide substitute or more readily available grades. Revision and simplification of some material specifications have been made, with many more in process, resulting in greater availability and ease of procurement of basic materials to the manufacturers.

The Rifled Bore Shell Committee likewise has had many interesting and profitable discussions during its meetings. Important decisions which will be beneficial to the manufacturers and to the Ordnance Department have been made. One of the important points which was settled related to the so-called nick-and-break method of inspection of shell bases which was causing manufacturers considerable difficulty. As a result of the work of the committee and the subcommittees which were formed to discuss this problem, the use of the macro-etch method of detecting pipes and seams in shell forgings was adopted as an alternate method of inspection.

INDUSTRY and the Ordnance Department have mutually benefited through this exchange of technical information. Perhaps the Ordnance Department has gained most, since it has secured the advisory services of the principal engineers in each field of activity. In this manner, all designs and engineering principles of ordnance matériel have been reviewed by many of our best engineers in industry. Such services otherwise could not have been purchased or secured. Industry has benefited through a better understanding of the service requirements of parts or equipment and the reasons behind certain design and manufacturing restrictions.

Through discussions, we have been able to point out the military conditions which have governed our designs. Based on the suggestions for minor changes in designs of parts, production has been facilitated and costs decreased. The meeting of the various manufacturers, with exchange of information regarding processing methods, procedures, and other manufacturing data has been of primary importance.

In the field of production, these meetings also have contributed greatly as industrial engineers have had an oppor-

tunity to review ordnance drawings, specifications, and manufacturing procedures and have suggested changes which have led to revisions to meet modern production standards. Ordnance engineers and designers cannot always take full advantage of commercial developments under normal conditions, and it becomes doubly difficult during an emergency. Consequently, the opinions and advice of industrial engineers are a necessity if quantity production is to be acquired quickly. The mutual coöperation in obtaining machine tools, raw materials, gages, and other necessities has done much to increase production.

But perhaps the greatest benefit of all has been the psychological reaction resulting from this direct contact between responsible Ordnance officers and the civilian engineers of industry. American industry has learned that the Ordnance officers and engineers desire to coöperate fully with them and to do everything possible which will make quantity production feasible. As one engineering representative of an important manufacturing facility expressed it after the first meeting: "I am surprised to find that Ordnance officers and engineers speak my language and seem so willing to coöperate." The meetings have done much to overcome the industrial conception of the massive immobility of Government agencies and have increased the desirability for Government contracts.

Today, the American manufacturers must learn from experienced Ordnance personnel the technique involved in the production of Ordnance weapons. Six or eight months later, the tables will be reversed somewhat, for then most manufacturers will have built this equipment, will have seen it tested, and will have become informed concerning the basic requirements under which the matériel was designed. This great body of American engineers and designers then will be in the position to contribute toward the further improvement of our ordnance equipment. At that time, the meetings of these committees may become even more important and valuable to the War Department than today. It now is expected to call meetings of these committees to acquaint the members with plans for the future development of ordnance and seek the advice of this great reservoir of engineering talent.

NO statement of the activities of the engineering advisory committees would be complete without reference to the research advisory committees which have been assisting the Ordnance Department in basic and technical research, in some cases for many years. One of these is the Ordnance Automotive Advisory Committee of the Society of Automotive Engineers, formed some twenty years ago. Col. H. W. Alden of the Timken-Detroit Axle Company has served as chairman throughout this period, and, except for the death of two members, its personnel has remained unchanged. The committee has met whenever the Chief of Ordnance has called on it for the solution of special problems relating to tanks and automotive equipment for the Army. Practically all our automotive research-and-development programs have been submitted to this committee for review and advice. It has met from time to time at the Aberdeen Proving Ground, at Fort Knox, and elsewhere to inspect new models of tanks, scout cars, armored cars, and tractors. The committee has formed an important link in keeping the Department abreast of the new developments in industry and in bringing to its attention new types of engines, transmissions, and other components which might be used to improve our tanks and armored vehicles.

Several years ago an S.A.E. Rubber Products Subcommittee was formed with J. E. Hale of Firestone Tire & Rubber Company as chairman. This subcommittee has met over a period of several years and has rendered invaluable aid on problems pertaining to the rubber components used in tank design and manufacture. This subcommittee has made especially important contributions to the development of rubber tracks for tanks, rubber suspensions, and similar items. Other subcommittees operating under the main S.A.E. Ordnance Automotive Advisory Committee are the powerplant subcommittee headed by Col. G. A. Green, vice-president of General Motors Truck & Coach Company; the subcommittee on transmissions, headed by L. R. Buckendale of Timken-Detroit Axle Company; and the subcommittee on suspensions, with Col. A. W. Herrington of Marmon-Herrington Company as chairman.

The Metallurgical Advisory Board, now divided into ferrous and nonferrous units has coöperated with the metallurgical laboratory at Watertown Arsenal for many years. Composed of outstanding civilian metallurgists, the board has been of great assistance to the Ordnance Department in the development of armor plate, special steels for guns, and similar metallurgical problems.

Similar committees are based upon the research laboratories located at our manufacturing arsenals and proving ground. There is a Ballistic Research Committee which meets at Aberdeen Proving Ground, and a Corrosion Committee, a Petroleum Products and Lubricants Committee, and a Paints, Varnishes and Related Products Committee that meet at Rock Island Arsenal to study problems involved in the use of ordnance equipment. An Explosives Committee is to be formed to meet at Picatinny Arsenal, the establishment engaged in the manufacture of ammunition.

IT HAS been very heartening to the officers of the Ordnance Department to find executives and engineers of industry not only willing but eager to coöperate with the Department in this great industrial effort for national defense. It has been a great pleasure to the writer to participate in the meetings of these engineering advisory committees. There has prevailed a spirit of friendliness and a desire to get the national-defense job completed in the best way and in the shortest time.

In the World War, manufacturers of ordnance equipment encountered great difficulties with our drawings and specifications. Unfortunately, time had not permitted the perfection of drawings, many of which were made after war had been declared by the United States.

Our engineering advisory committees of today, with frequent visits to our manufacturing arsenals between committee meetings, have very largely eliminated the difficulties, errors, and misunderstandings which have arisen in the use of ordnance drawings and specifications. During the course of these meetings it has become apparent that manufacturers have found ordnance drawings and specifications in the main satisfactory. The serious delays due to these causes in the World War will not hamper national defense in the present emergency.

The United States surpasses all other countries in its potential industrial capacity for the manufacture of war equipment. Its engineers are likewise the world's best. These advisory engineering and research committees will enable the Ordnance Department to take full advantage of this great reservoir of engineering and scientific talent, and to use it most effectively for the national defense of the United States.

Ordnance Engineering and Research

Committees on Development and Manufacture of Armament

Ordnance Engineering Advisory Committees

I. COMMITTEES ON ARTILLERY AND AUTOMOTIVE MATÉRIEL

1. Tank Committee

Industrial Representatives:

American Car & Foundry Co., Berwick, Pa.: H. B. Ensign, H. O. Amble, Wm. Stancliffe, Guy Beishline.

American Locomotive Co., Schenectady, N. Y.: M. Bell, Roger W. Clifford, C. J. Currie.

Baldwin Locomotive Works, Philadelphia, Pa.: H. S. Colby (chairman), G. H. Froebel, K. T. Sorenson, L. G. Fisher.

Chrysler Corporation, Detroit, Mich.: C. J. Hunt, T. Woolson, E. C. Dodt, M. Blake, M. Y. Leonard.

Lima Locomotive Co., Lima, Ohio: A. J. Townsend, F. C. Cutter, R. B. Krueger, O. B. Schultz, A. E. Feightner.

Pressed Steel Car Co., Pittsburgh, Pa.: S. Bechhold, R. Mitchell, Carl Hansen, F. L. Johnson, Alex Blain.

Pullman-Standard Car Manufacturing Co., Chicago, Ill.: R. M. Fox, B. J. Trautman.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Col. H. W. Alden, Lieut. Col. W. A. Borden, Capt. C. M. Buhl, F. G. Alborn, Sr., E. L. Hollady.

Office, Assistant Chief of Industrial Service, Production: R. T. Kent.

Artillery Division, Industrial Service: Lieut. Col. W. W. Warner, Maj. D. J. Crawford, Jr., J. Proske, V. F. Lucht.

Technical Staff, Artillery & Automotive Division: Lieut. Col. F. J. Atwood.

Arsenal Representatives:

Rock Island Arsenal: Frank Sunderland, William J. Brown.

Ordnance District Representatives:

Chicago Ordnance District: Joseph E. Kanaley.

Cincinnati Ordnance District: Capt. W. V. Luck.

Cleveland Ordnance District: Wm. Waltermire.

Detroit Ordnance Plant: Lieut. Col. H. W. Rehm, Capt. R. J. Bedell.

New York Ordnance District: Maj. F. R. Mead.

Philadelphia Ordnance District: Maj. D. N. Hauseman, Lieut. A. J. Seiler.

Pittsburgh Ordnance District: Maj. John S. Swauger.

Proving Ground Representatives:

Aberdeen Proving Ground: Col. William B. Hardigg, Lieut. Col. John K. Christmas, Capt. Joseph M. Colby.

(Acting under the direction of the Tank Committee are a subcommittee on purchases, a subcommittee on gages, and a subcommittee on specifications.)

2. Half-Track Vehicle Committee

Industrial Representatives:

Autocar Co., Ardmore, Pa.: B. B. Bachman (chairman).

Diamond T Motor Car Co., Chicago, Ill.: C. A. Pierce.

Mack Manufacturing Co., Allentown, Pa.: L. C. Josephs, Jr., Franklin R. Nail.

Marmon-Herrington Co., Indianapolis, Ind.: A. W. S. Herrington, C. Wallace.

White Motor Co., Cleveland, Ohio: F. MacCrae, B. F. Jones, H. Collins.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Col. H. W. Alden, Lieut. Col. W. A. Borden, Capt. C. M. Buhl, F. G. Alborn, Sr., A. J. Scaife, Sr.

Office, Assistant Chief of Industrial Service, Production: Maj. W. E. Niles.

Artillery Division, Industrial Service: Lieut. Col. W. W. Warner, Maj. J. E. McInerney, Maj. E. L. Cummings, C. Hiller.

3. Mobile Artillery Carriage Committee

Industrial Representatives:

American Locomotive Co., New York, N. Y.: C. M. Bell, W. G. Miller, E. N. Boswell, R. C. Paul, E. L. Richardson, C. L. Dixon.

American Type Founders, Inc., Elizabeth, N. J.: C. E. Ferguson, Frank Glazer.

American Munitions Division (American Type Founders, Inc.), Elizabeth, N. J.: J. Stuart Sneddon, H. H. Edge.

J. G. Brill Co., Philadelphia, Pa.: C. O. Guernsey, Elmer Latshaw.

Bucyrus-Erie Co., Milwaukee, Wis.: N. R. Knox, T. Davidson, H. Squires, R. Woodward.

Byron Jackson Co., Los Angeles, Calif.: C. H. Nazro.

Duplex Printing Press Co., Battle Creek, Mich.: W. W. Stoothoff, G. Toole, R. Gerheart, C.W. Galen, W. Fulcher.

Gar Wood Industries, Inc., Detroit, Mich.: R. S. Jenkins.

Hannifin Manufacturing Co., Chicago, Ill.: V. W. Peterson, O. J. Maha, E. M. Foster.

Parish Pressed Steel Co., Reading, Pa.: S. L. Whitehall.

Pettibone Mulliken Corporation, Chicago, Ill.: G. E. Campbell, James J. Kuker, R. F. Marsden.

Pullman-Standard Car Manufacturing Co., Hammond, Ind.: B. J. Trautman, Edward Dubois, E. D. Morris.

Timken-Detroit Axle Co., Detroit Mich.: Col. H. W. Alden.

York Safe & Lock Co., York, Pa.: J. W. Hennessey (chairman), C. Lindstrom.

Ordnance Office Representatives:

Assistant, Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Maj. J. H. Frye.

Office of Assistant Chief of Industrial Service, Production: F. W. Ayers, R. T. Kent.

Artillery Division, Industrial Service: Maj. T. A. Weyher, Lieut. H. A. McKerral, D. A. Gurney, O. L. Beardsley, L. C. Leasure.

Technical Staff: Lieut. Col. F. J. Atwood, A. B. Whittet.

Arsenal Representatives:

Rock Island Arsenal: Brig. Gen. N. F. Ramsey, Lieut. Col. E. C. Goebert, Lieut. Col. C. A. Waldmann, Lieut. Col. W. J. Crook, E. O. Olson, M. W. Johnson, F. C. Glass, Paul Cunnick.

Ordnance District Representatives:

Cincinnati Ordnance District: P. B. Mueller.

Chicago Ordnance District: Capt. Lionel J. Brunton.

Detroit Ordnance District: Lieut. C. A. Gerstacker.

Ordnance Engineering Advisory Committees

New York Ordnance District: Maj. F. R. Mead.
Philadelphia Ordnance District: Maj. W. S. Broberg.
San Francisco Ordnance District: Capt. M. S. Hugo.

4. Antiaircraft Carriage Committee

Industrial Representatives:

Aetna-Standard Engineering Co., Youngstown, Ohio: Lieut. Col. W. W. Golden, Robert Johnson.
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.: E. H. Brown, Mr. Grouthouse.
R. Hoe & Co., New York, N. Y.: J. L. Auer (chairman).
Bartlett Hayward Division (Koppers Co.), Baltimore, Md.: W. F. Perkins, E. R. Hall, F. H. Linthicum, G. W. Shafer.
Otis Elevator Co., New York, N. Y.: M. C. Zederbaum.
Worthington Pump & Machinery Corporation, Harrison, N. J.: A. C. Armstrong.
York Safe & Lock Co., York, Pa.: J. W. Hennessey.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Maj. J. H. Frye, H. L. McCormick.
Artillery Division, Industrial Service: Maj. G. M. Taylor, Maj. D. J. Martin, Lieut. S. B. West, August Dabrasky, L. C. Leasure.
Technical Staff: Lieut. Col. F. J. Atwood, Maj. W. J. Crowe, W. E. Yocum.

Arsenal Representatives:

Watertown Arsenal: Brig. Gen. R. W. Case, Col. John Mather, Frederic Trickey, Maurice F. Healy.

Ordnance District Representatives:

Chicago Ordnance District: Capt. Lionel J. Brunton.
Cleveland Ordnance District: Henry F. Gammeter.
New York Ordnance District: Maj. F. R. Mead.
Philadelphia Ordnance District: W. W. Henry, R. E. Layton.

5. Automatic Cannon Committee

Industrial Representatives:

Bendix Aviation Corporation, Elmira, N. Y.: M. P. Whitney, Stanley B. Kurzina.
Chrysler Corporation, Detroit, Mich.
Colts' Patent Fire Arms Manufacturing Co., Hartford, Conn.: G. Webb (chairman), W. L. Swartz, C. R. Lewis.
International Business Machines Corporation, Endicott, N. Y.: E. B. VanDeusen, F. M. Carroll.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Maj. J. H. Frye.
Office, Assistant Chief of Industrial Service, Production: F. W. Ayers.
Artillery Division, Industrial Service: Maj. D. J. Martin, Lieut. A. W. Swart, Lieut. G. M. Yatsevitch, D. A. Gurney, P. M. Netzer.
Technical Staff: Capt. H. A. Quinn, W. E. Yocum.

Arsenal Representatives:

Watervliet Arsenal: Brig. Gen. A. G. Gillespie, Maj. S. L. Conner, A. H. Maggs, L. W. Dwyer.

Ordnance District Representatives:

Detroit Ordnance District: Lieut. Col. R. Z. Crane.
Hartford Ordnance District: F. W. Hauff, Carl DeLeon.

6. Fire-Control Committee

Industrial Representatives:

Bausch & Lomb Optical Co., Rochester, New York: C. L. Bausch.
Bell & Howell Co., Chicago, Ill.: C. E. Phillimore.
Bendix Aviation Corporation, New York, N. Y.: C. H. Havill.
Breeze Corporations, Inc., Newark, N. J.: J. D. Marks.
Delco Appliance Division (General Motors Corporation), Rochester, N. Y.: J. H. Schick, A. A. Gloetzner.
Eastman Kodak Co., Rochester, N. Y.: A. Stuber, W. T. Roach.
Fairchild Aviation Corporation, Jamaica, N. Y.: George Rattray, R. G. Sanders, J. F. Steigerwald.
Gilbert & Barker Manufacturing Co., Springfield, Mass.: S. C. Hope, T. C. O'Donnell, H. F. Tapp.
W. & L. E. Gurley Co., Troy, N. Y.: C. I. Day, W. L. Egy.
Hobart Manufacturing Co., Troy, Ohio: G. B. Fox, D. A. Meeker.
Keuffel & Esser Co., Hoboken, N. J.: C. W. Keuffel.
W. L. Maxson Corporation, New York, N. Y.: W. L. Maxson, P. J. McLaren, J. A. Vaughan, F. W. Lutz.
Mergenthaler Linotype Co., Brooklyn, N. Y.: G. W. Allison (chairman).
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.: R. L. Goetzenberger.
Safety Car Heating & Lighting Co., New York, N. Y.: G. E. Hulse.
Simpson Optical Co., Chicago, Ill.: J. S. Eagen.
Singer Sewing Machine Co., Elizabethport, N. J.: W. J. Peets, C. T. Willard.
Spencer Lens Co., Buffalo, N. Y.: S. J. Bailey, A. H. Bennett.
Sperry Gyroscope Co., Brooklyn, N. Y.: E. W. Chafee, F. S. Hodgman, H. R. Menefee.
Williams Oil-O-Matic Heating Corporation, Bloomington, Ill.: E. Nesmith, R. H. Ellerbrook.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Maj. J. H. Frye, B. S. McCutchen.
Artillery Division, Industrial Service: Lieut. Col. W. W. Warner, Maj. G. M. Taylor, Capt. R. T. Brice, Lieut. S. B. West, J. C. Karnes.
Technical Staff: R. C. Darnell.
Office, Assistant Chief of Industrial Service, Production: Maj. W. P. Rawls.

Arsenal Representatives:

Frankford Arsenal: Lieut. Col. G. B. Welch, Lieut. Col. G. M. Wells, Maj. G. W. Trichel, Capt. P. W. Shumate, J. O. Bluhm, E. A. Fricke, O. K. Kaspereit, W. E. Krotee.

Ordnance District Representatives:

Cincinnati Ordnance District: L. Munger Means.
Chicago Ordnance District: 1st Lieut. Gerald R. Stewart.
Hartford Ordnance District: C. E. Horton, Capt. W. M. Jahn, J. I. Mackenzie.
New York Ordnance District: G. A. Foisy.
Rochester Ordnance District: Lieut. Col. R. L. Bowlin, Lieut. J. S. Nyers, H. D. Ashton.

7. Gun Machining Committee

Industrial Representatives:

American Munitions Division (American Type Founders, Inc.), Elizabeth, N. J.: J. Stewart Sneddon, H. H. Edge.
Chain Belt Co., Milwaukee, Wis.: J. T. Brown (chairman), W. J. Sparling, L. H. Bosnian.
C. H. Cowdrey Machine Works, Fitchburg, Mass.: Carl W. H. Cowdrey, George B. Warner.
General Electric Co., Erie, Pa.: H. G. Chase.
Kennedy-Van Saun Manufacturing & Engineering Co., Danville, Pa.: F. O. Reedy, W. F. Gittler.
Mesta Machine Co., Pittsburgh, Pa.: Charles Raisig.

Ordnance Engineering Advisory Committees

Midvale Co., Philadelphia, Pa.: L. S. Divan, Amos Cole, E. J. McGuigan.

National Pneumatic Co., Rahway, N. J.: H. Nock, William Nickau, E. A. Roy.

Pullman-Standard Car Manufacturing Co., Hammond, Ind.: B. J. Trautman.

Read Machinery Co., York, Pa.: James T. Duffy, Jr.

Wheland Co., Chattanooga, Tenn.: C. W. Wheland.

United Engineering & Foundry Co., Youngstown, Ohio.: E. E. Tross, M. A. McClain.

United Shoe Machinery Corporation, Boston, Mass.: Henry S. Hubbell, E. L. Bartholomew, J. V. Baxter.

Vilter Manufacturing Co., Milwaukee, Wis.: F. T. Goes, L. Niemchek.

York Safe & Lock Co., York, Pa.: J. W. Hennessey, C. Lindstrom.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden.

Office, Assistant Chief of Industrial Service, Production: R. T. Kent.

Artillery Division, Industrial Service: Lieut. Col. W. W. Warner, Maj. D. J. Martin, Lieut. A. W. Swart, Wm. Summerbell.

Technical Staff: Maj. W. J. Crowe.

Arsenal Representatives:

Watervliet Arsenal: Brig. Gen. A. G. Gillespie, Lieut. Col. H. F. Safford, Maj. S. L. Connor, C. T. Kohler, L. W. Dwyer.

Ordnance District Representatives:

Boston Ordnance District: F. C. Meyer, R. A. Gibson, F. J. Peterson.

Chicago Ordnance District: Robert C. Deale, Lieut. Col. Barret Rogers.

Cincinnati Ordnance District: Lieut. Col. Fred A. McMahon, Lieut. C. C. Hehl, W. R. Martin.

Cleveland Ordnance District: Capt. W. B. McClelland, J. T. Radley.

New York Ordnance District: Maj. F. R. Mead.

Philadelphia Ordnance District: Lieut. J. H. Beyer.

Pittsburgh Ordnance District: Lieut. Col. James L. Guion, Lieut S. R. Dickinson.

8. Gun-Forging Committee

This committee will consist of representatives from the following manufacturers of this class of matériel: A. Finkle & Sons Co., Chicago, Ill.; Allegheny Forging Co., Pittsburgh, Pa.; American Locomotive Co., New York, N. Y.; Bethlehem Steel Co., Bethlehem, Pa.; Camden Forge Co., Camden, N. J.; Crucible Steel Co. of America, New York, N. Y.; Edgewater Steel Co., Pittsburgh, Pa.; Midvale Co., Nicetown, Philadelphia, Pa.; National Forge & Ordnance Co., Irvine, Warren County, Pa.; Struthers Wells-Titusville Corporation, Titusville, Pa.

II. COMMITTEES ON AMMUNITION MATÉRIEL

1. Rifled-Bore Shell Committee

Industrial Representatives:

American Car & Foundry Co., New York, N. Y.: W. L. Stancliffe.

American Forge Division (American Brake Shoe & Foundry Co.), Chicago, Ill.: W. E. Crocombe (chairman), H. Mulford, A. R. Nettenstrom, C. M. McGrath.

Armstrong Cork Co., Lancaster, Pa.: Jesse R. Smith, A. Jones.

Babcock Printing Press Corporation, New London, Conn.: Noah MacDowell, Jr., H. W. Faeber.

Baldwin Locomotive Works, Philadelphia, Pa.: F. G. Schranz, G. H. Froebel, A. G. Hochbaum, L. S. Divan.

Bauer Brothers Co., Springfield, Ohio: J. C. Shouvlin, R. J. Shouvlin, Kenneth Brodbeck, Hollis Arnold.

Bethlehem Steel Co., Bethlehem, Pa.: G. B. Troxell, J. A. Taylor.

Budd Wheel Co., Detroit, Mich.: C. L. Eksergian, E. W. Buell, E. A. Clark.

Colorado Fuel & Iron Corporation, Denver, Colo.: W. H. Bailey.

Columbian Iron Works—Mueller Co., Chattanooga, Tenn.: P. G. Jacka, R. H. Tauber.

Crucible Steel Co. of America, Harrison, N. J.: J. S. Wickham.

General Railway Signal Co., Rochester, N. Y.: J. F. Kelley, T. H. Morcom.

Goslin Birmingham Manufacturing Co., Birmingham, Ala.

International Harvester Co., Chicago, Ill.: J. J. Rodgers.

J. I. Case Co., Racine, Wis.: H. G. Barr, J. F. Crawford.

Kilby Steel Co., Anniston, Ala.: T. E. Kilby, Jr.

Kingston Products Corporation, Kokomo, Ind.: M. E. Zimmerer.

LeTourneau Co. of Georgia, Toccoa, Ga.

Moline Forge, Inc., Moline, Ill.: H. W. Getz.

Omaha Steel Works, Omaha, Nebr.

National Supply Co., Pittsburgh, Pa.: W. M. Frame, Wm. F. Hart.

National Tube Co., Pittsburgh, Pa.: E. C. Wright, D. W. Fletcher, W. R. Davis.

General Motors Forge Plant—Division Olds Motor Works (General Motors Corporation), Lansing, Mich.: F. R. Nethaway, K. C. Plasterer

Lansdowne Steel & Iron Co., Morton, Pa.

Pittsburgh Forgings Co., Coraopolis, Pa.: W. H. Stocking.

Pressed Steel Car Co., Pittsburgh, Pa.: H. J. Rushton, J. C. Ritchey.

Pullman-Standard Car Manufacturing Co., Butler, Pa.: C. W. Wright, W. G. Helsel, C. L. McKindree, Oscar Otterson.

S. A. Woods Machine Co., Boston, Mass.: H. C. Dodge, K. Dunwoody, L. E. Blood.

Schwitzer-Cummins Co., Indianapolis, Ind.: C. E. Maudlin, A. J. Newsom.

Standard Forgings Corporation, Chicago, Ill.: R. W. Clansky, J. A. Cook, C. S. Swanson.

Stockham Pipe Fitting Co., Birmingham, Ala.: A. H. White.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.: W. G. Hulbert, C. B. Andrews.

Tennessee Coal Iron & Railroad Co., Birmingham, Ala.: R. H. Ledbetter.

Tube Turns, Inc., Louisville, Ky.: E. G. Luening, C. J. Hodapp, N. C. Dooley.

U. S. Machine Corporation, Lebanon, Ind.: C. J. Winkler, Maurice Winkler, Herman Winkler.

Walworth Co., Kewanee, Ill.: R. E. Laggren, C. L. Lane.

Willys-Overland Motors, Inc., Toledo, Ohio.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: Lieut. Col. C. E. Davies, Maj. E. N. Clark, Capt. R. M. Wood, Lieut. J. A. Rice, G. B. Agnew, Jr.

Ammunition Division, Industrial Service: Col. F. H. Miles, Jr., Lieut. Col. M. W. Kresge, Lieut. K. B. Mickelwait, W. F. Stevenson.

District Control Division, Industrial Service: Lieut. N. T. Dennis.

Technical Staff: Lieut. Col. K. F. Adamson, A. Adelman.

Ordnance Engineering Advisory Committees

Arsenal Representatives:

Frankford Arsenal: Lieut. Col. E. C. Bomar, Capt. R. M. Spengler, Charles Gazioso.

Picatinny Arsenal: A. F. Teitscheid.

Ordnance District Representatives:

Birmingham Ordnance District: Lieut. Col. W. F. Vander Hyden.

Boston Ordnance District: J. W. Bechtel.

Chicago Ordnance District: Lieut. Col. F. R. Zimmerman, Lieut. Col. F. A. McMahon.

Cincinnati Ordnance District: Lieut. J. H. Peacock, Lieut. F. A. Christoffer.

Cleveland Ordnance District: Maj. H. M. Reedall, Lieut. J. R. Van Rensselaer, H. F. Gammeter.

Detroit Ordnance District: Lieut. Col. R. Z. Crane, Capt. M. L. Ash, Jr., S. O. A. Peterson.

Hartford Ordnance District: Maj. C. W. Vogt, R. C. Charest.

Philadelphia Ordnance District: Maj. W. S. Broberg.

Pittsburgh Ordnance District: Lieut. Col. J. L. Guion, Maj. John S. Swauger.

Rochester Ordnance District: Maj. A. J. Zimmerman, Lieut. K. B. Castle.

St. Louis Ordnance District: Maj. R. J. Hogan, Capt. Frank Marriott.

2. Smooth-Bore Shell Committee

Industrial Representatives:

Auto Specialties Manufacturing Co., St. Joseph, Mich.: Frank Shumann.

Budd Wheel Co., Detroit, Mich.: H. N. McMenimen, Jr.

Link Belt Co., Indianapolis, Ind.: Frank Shumann.

Murray Manufacturing Co., Brooklyn, N. Y.: Mr. Phelps.

National Malleable & Steel Castings Co., Cleveland, Ohio: H. W. Gilbert.

Portland Forge & Foundry Co., Portland, Ind.: D. A. Hall.

Texasteel Manufacturing Co, Fort Worth, Tex.: A. J. Armstrong, C. H. Baldwin.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: Capt. R. M. Wood, Lieut. J. A. Rice.

Ammunition Division, Industrial Service: Lieut. Col. M. W. Kresge, Lieut. K. B. Mickelwait, Lieut. D. K. Greenwald, Dr. M. S. Falk, G. M. Taliaferro.

District Control Division, Industrial Service: Lieut. Col. W. E. Becker.

Technical Staff: Capt. G. A. Zellar.

Arsenal Representatives:

Frankford Arsenal: Capt. R. M. Spengler, Charles G. Grazioso.

Picatinny Arsenal: Wade H. Ewart.

Ordnance District Representatives:

Cincinnati Ordnance District: Capt. C. O. Schmidt.

Cleveland Ordnance District: Lieut. Norman T. Dennis.

Detroit Ordnance District: Lieut. M. L. Ash, Jr., Floyd G. McCauley.

New York Ordnance District: Maj. G. I. Ross.

Philadelphia Ordnance District: John J. Target.

St. Louis Ordnance District: Arthur C. Settlage.

3. Bar-Stock Shell Committee

Industrial Representatives:

G.M.Co Manufacturing Co., Long Island City, N. Y.: A. J. Graham, G. S. Iskyan.

Delco Products Division (General Motors Corporation), Dayton, Ohio: R. A. Winefordner, S. W. Blanton (chairman).

Eclipse Machine Division (Bendix Aviation Corporation), Elmira, N. Y.: R. T. Hurley.

National Cash Register Co., Dayton, Ohio: John W. Humphrey, C. E. Stines.

National Pneumatic Co., Rahway, N. J.: N. A. Partenope.

Oil Well Supply Co., Oil City, Pa.: F. B. Bayless.

Smith Brothers Manufacturing Co., Carthage, Mo.

Tuthill Pump Co., Chicago, Ill.: M. W. Huber.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. Wm. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: G. B. Agnew, Jr.

Ammunition Division, Industrial Service: Lieut. Col. M. W. Kresge, Lieut. K. B. Mickelwait, Dr. M. S. Falk, G. M. Taliaferro.

District Control Division, Industrial Service: Maj. J. L. Holman.

Technical Staff: Lieut. Col. K. F. Adamson.

Arsenal Representatives:

Frankford Arsenal: Capt. R. M. Spengler, C. G. Grazigo.

Picatinny Arsenal: A. F. Teitscheid.

Ordnance District Representatives:

Chicago Ordnance District: Burton W. Collins.

Cincinnati Ordnance District: Lieut. J. J. Campbell.

New York Ordnance District: Lieut. Clifford F. Kaiser.

Pittsburgh Ordnance District: Capt. John Redmond.

Rochester Ordnance District: W. W. Briggs.

4. Demolition Bomb Body Committee

Industrial Representatives:

American Car & Foundry Co., New York, N. Y.: C. E. Reedy, J. O. Kline, V. R. Whitenight, J. W. Steinmeyer, J. W. Lehr.

Bethlehem Steel Co., Bethlehem, Pa.: G. B. Troxell, I. S. Reiter, J. A. Taylor, A. P. Spooner.

Harrisburg Steel Corporation, Harrisburg, Pa.: Wilbert Wear, H. B. Liggett, Jens Clausen, K. H. Caskey.

National Tube Co., Pittsburgh, Pa.: E. C. Wright, W. R. Davis.

A. O. Smith Corporation, Milwaukee, Wis.: R. Furrer, C. Larson, H. H. Needham, A. Pokras.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Lieut. Col. A. B. Domonoske.

Office, Assistant Chief of Industrial Service, Production: Maj. E. N. Clark, Lieut. J. A. Rice.

Ammunition Division, Industrial Service: Col. F. H. Miles, Lieut. Col. S. R. Stribling, Maj. R. G. Butler, Lieut. R. F. Greenawalt, H. S. Beckman (chairman), Dr. M. S. Falk.

Technical Staff, Ammunition Division: Arthur Adelman.

Arsenal Representatives:

Watertown Arsenal: Lieut. Col. S. B. Ritchie, H. C. Mann.

Picatinny Arsenal: J. M. King.

Ordnance District Representatives:

Chicago Ordnance District: John Whyte.

Cincinnati Ordnance District: Lieut. J. D. Tewel.

Philadelphia Ordnance District: John J. Target.

Ordnance Engineering Advisory Committees

Pittsburgh Ordnance District: Lieut. Col. James L. Guion, Lieut. S. A. Wenk.

5. Pyrotechnics Committee

Industrial Representatives:

Atlas Powder Co., Ooltewah, Tenn.: W. E. Hazeltine.

Austin Powder Co., Cleveland, Ohio: A. D. Alexander.

M. Backes' Sons, Wallingford, Conn.: C. B. Backes, R. V. Moon.

Essex Specialty Co., Berkley Heights, N. J.: Milton M. Adler, Bernard Goldsmith.

International Flare Signal Division (Kilgore Manufacturing Co.), Tipp City, Ohio: A. F. Hubbard.

National Fireworks, Inc., Boston, Mass.: E. V. Babbitt, H. H. Whitmore, Warner Thrasher.

New Jersey Fulgent Co., Metuchen, N. J.: Samuel D. Wiley (chairman).

Triumph Explosives, Inc., Elkton, Md.: John J. Prial, S. M. Feldman, B. I. Stoops.

Unexcelled Manufacturing Co., New York, N. Y.: Clark B. Allen.

A. L. Due Branch (Unexcelled Manufacturing Co.), Reading, Ohio:

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: Maj. E. N. Clark, Lieut. J. A. Rice.

Ammunition Division, Industrial Service: Col. F. H. Miles, Lieut. Col. S. R. Stribling, Maj. R. G. Butler, Lieut. R. F. Greenawalt, Lieut. C. V. Scantlebury, Dr. M. S. Falk, H. S. Beckman.

Technical Staff, Industrial Service: Arthur Adelman.

Arsenal Representatives:

Picatinny Arsenal: W. H. Rinkenbach, H. S. Eroe.

Ordnance District Representatives:

Boston Ordnance District: R. E. Crowley.

Cincinnati Ordnance District: Lieut. W. J. Miller.

Chicago Ordnance District: Lieut. Goff Smith.

Cleveland Ordnance District: Lieut. M. K. Henderson, Lieut. Frank J. Long.

Hartford Ordnance District: Capt. W. M. Jahn.

New York Ordnance District: Maj. Gilbert I. Ross.

Philadelphia Ordnance District: Capt. A. Hamilton, Joseph A. McCambridge.

6. Bomb-Fuze Committee

Industrial Representatives:

Atlas Ansonia Co., New Haven, Conn.: T. T. Logie.

Briggs & Stratton Corporation, Milwaukee, Wis.: C. L. Coughlin, E. V. Oehler, O. F. Gottleib.

Chrysler Corporation, Detroit, Mich.: H. L. Weckler.

Corbin Screw Co., New Britain, Conn.: J. P. Baldwin, R. L. Hughes.

Cushman Motor Works Co., Lincoln, Nebr.: Chas. D. Ammon, R. H. Ammon, R. M. Snyder, M. R. Sherwood, John Worrest, Wm. Artz.

Delco Products Division (General Motors Corporation), Dayton, Ohio: W. A. Chryst, R. C. Stupp, S. W. Blanton.

Grayson Heat Control, Ltd., Lynwood, Calif.: J. A. Robertshaw, K. L. Dynes, H. T. Ryan.

National Pneumatic Co., Rahway, N. J.: H. Nock.

Peco Manufacturing Corporation, Philadelphia, Pa.: W. F. Errig.

Stewart-Warner Corporation, Chicago, Ill.: C. W. Hooper, J. E. Burke.

Westinghouse Electric & Manufacturing Co., Springfield, Mass.: P. E. Rhicard (chairman), A. L. Atherton.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye, H. B. Hambleton.

Office, Assistant Chief of Industrial Service, Production: Lieut. J. A. Rice.

District Control Division, Industrial Service: Lieut. Col. W. E. Becker.

Ammunition Division, Industrial Service: Col. F. H. Miles, Lieut. Col. S. R. Stribling, Maj. R. G. Butler, Lieut. R. F. Greenawalt, Dr. M. S. Falk, H. S. Beckman.

Arsenal Representatives:

Picatinny Arsenal: J. M. King.

Ordnance District Representatives:

Chicago Ordnance District: Irving A. Pratt.

Cincinnati Ordnance District: Lieut. J. J. Campbell.

Hartford Ordnance District: L. Roberti, J. D. Turci, E. B. Feaster.

New York Ordnance District: Maj. G. I. Ross.

Philadelphia Ordnance District: John J. Target, Mr. Cosgrove.

St. Louis Ordnance District: Capt. Frank Marriott, Lieut. A. R. Burgess, A. Lockey.

7. Primer and Detonator Committee

Industrial Representatives:

Automatic Machine Products Co., Attleboro, Mass.: John S. Holden.

E. F. Griffiths Co., Germantown, Pa.: John C. Clark.

Mattatuck Manufacturing Co., Waterbury, Conn.: L. A. Osborne.

McLaren Screw Products Co., Detroit, Mich.:

Mueller Brass Co., Port Huron, Mich.: E. E. Sutter.

Pollak Manufacturing Co., Arlington, N. J.: L. L. Pollak, C. Schlesinger, H. E. Davies, T. P. Breen.

Remington Arms Co., Bridgeport, Conn.: E. C. Hadley, T. F. Werme.

Standard Pressed Steel Co., Jenkintown, Pa.: H. T. Hallowell, Jr. (chairman).

Triumph Explosives, Inc., Elkton, Md.: J. J. Prial, S. M. Feldman.

Western Cartridge Co., East Alton, Ill.: B. E. Bassett, Martin Newcomer, E. G. Mitchell, A. G. Schuricht, V. N. Crasnoff.

Winchester Repeating Arms Co., New Haven, Conn.: Edwin Pugsley.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. Wm. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: Capt. R. M. Wood.

Ammunition Division, Industrial Service: Col. F. H. Miles, Jr., Lieut. Col. S. R. Stribling, Lieut. Col. Miles W. Kresge, Lieut. Col. M. H. Davis, Lieut. G. H. Berlin, Jr., W. F. Stevenson, Dr. M. S. Falk, Frank Jervy.

District Control Division, Industrial Service: Lieut. Col. A. B. Quinton, Jr.

Technical Staff: Lieut. Col. K. F. Adamson.

Arsenal Representatives:

Frankford Arsenal: Col. James Kirk, G. A. Miller, Jr.

Picatinny Arsenal: V. R. Reed, J. R. Taylor.

Ordnance Engineering Advisory Committees

Ordnance District Representatives:

Boston Ordnance District: Capt. G. Oetinger, Jr.
Chicago Ordnance District: Wm. H. Potter.
Cincinnati Ordnance District: Lieut. J. J. Campbell.
Hartford Ordnance District: Maj. C. W. Vogt, Rex M. A. Fermier, W. S. Valentine, W. H. Eister.
New York Ordnance District: Lieut. C. F. Kaiser.
Philadelphia Ordnance District: Capt. A. Hamilton, J. W. Ogden.
St. Louis Ordnance District: Capt. Frank Marriott.

8. Cartridge-Case Committee

Industrial Representatives:

Albert & J. M. Anderson Manufacturing Co., Boston, Mass.: A. E. Anderson.
Bossert Co., Utica, N. Y.: J. S. Schneider, E. S. Kinney.
Bridgeport Brass Co., Bridgeport, Conn.: P. H. Stapley, C. D. H. Kellog (chairman), A. D. Merwin.
Chase Brass & Copper Co., Waterbury, Conn.: Francis R. O'Leary, W. C. Husted.
Eastern Rolling Mill Co., Baltimore, Md.: Frank T. Leilich.
Globe Machine & Stamping Co., Cleveland, Ohio: Geo. B. Williams.
Guide Lamp Division (General Motors Corporation), Anderson, Ind.: C. A. Michel, E. Turnquist.
Ingersoll Steel & Disc Division (Borg-Warner Corporation), Chicago, Ill.: J. Paul Ahlbrandt.
Mullins Manufacturing Co., Warren, Ohio: G. F. Keyes.
Norris Stamping & Manufacturing Co., Los Angeles, Calif.: Harry L. Grant.
Revere Copper & Brass Co., Chicago, Ill.: G. N. Boyd.
Schwitzer-Cummins Co., Indianapolis, Ind.: A. J. Newsom, Orville Baxter.
Scovill Manufacturing Co., Waterbury, Conn.: A. C. Lusher, Philip A. Reutter.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. Wm. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.
Office, Assistant Chief of Industrial Service, Production: Capt. R. M. Wood.
Ammunition Division, Industrial Service: Col. F. H. Miles, Jr., Lieut. Col. S. R. Stribling, Lieut. Col. Miles W. Kresge, Lieut. Col. M. H. Davis, Lieut. D. K. Greenwald, W. F. Stevenson, Dr. M. S. Falk, Frank Jervey.
District Control Division, Industrial Service: Lieut. Col. A. B. Quinton, Jr.
Technical Staff, Industrial Service: Lieut. Col. K. F. Adamson.

Arsenal Representatives:

Frankford Arsenal: Lieut. Col. E. C. Bomar, F. J. Lerro.

Ordnance District Representatives:

Boston Ordnance District: G. L. Ladd.
Chicago Ordnance District: Lieut. James R. Ireland.
Cincinnati Ordnance District: Capt. C. D. Schmidt, Lieut. S. E. Hess.
Cleveland Ordnance District: Maj. H. M. Reedall, Lieut. J. R. Van Rensselaer.
Hartford Ordnance District: Carl De Leon, J. J. Hassett, D. J. O'Neill.
Philadelphia Ordnance District: Capt. Andrew Hamilton, Mr. Boertzel.
Rochester Ordnance District: Maj. A. J. Zimmerman, Lieut. K. B. Castell, Jr.

9. Artillery Fuze Committee

Industrial Representatives:

Bohn Aluminum & Brass Corporation, Detroit, Mich.: A. W. Rich, J. O. Wade, B. B. Brooks.
Briggs & Stratton Corporation, Milwaukee, Wis.: O. F. Gottlieb.
Carter Carburetor Corporation, St. Louis, Mo.: H. C. Weed, W. M. Ewart, W. F. Peterson.
Doehler Die Casting Co., Pottstown, Pa.: H. Doehler, L. H. Pillion, J. J. Loughran.
Economy Fuze & Manufacturing Co., Chicago, Ill.: F. J. Smetana.
Electric Auto-Lite Co., Toledo, Ohio: C. W. Pound, C. F. Gilchrist, L. E. Koos.
Federal Screw Works, Detroit, Mich.: F. M. Edgar.
Fulton Sylphon Co., Knoxville, Tenn.: Wm. L. Chandler, S. R. Simpson, S. W. Steele, G. M. Moss.
Delco Products Division (General Motors Corporation), Dayton, Ohio: S. W. Blanton, Milton Feldstein, R. A. Winefordner.
Hoover Co., North Canton, Ohio: E. C. Schmidt.
Independent Lock Co., Fitchburg, Mass.: G. W. Falk.
Landis Machine Co., St. Louis, Mo.: Ernest Dunford.
McLaren Screw Products Co., Detroit, Mich.: R. L. Stewart.
Mueller Brass Co., Port Huron, Mich.: E. E. Sutter.
Mt. Vernon Die Casting Co., Mt. Vernon, N. Y.
National Cash Register Co., Dayton, Ohio: C. H. Kindl, Burson Treadwell (chairman), F. A. Schultz, C. E. Stine.
Philco Corporation, Philadelphia, Pa.: John Schaeffer, S. F. Benner, C. H. Godschall.
Pollak Manufacturing Co., Arlington, N. J.: H. E. Davies.
Scovill Manufacturing Co., Waterbury, Conn.: M. L. Sperry, Jr., A. C. Lusher, P. A. Reutter.
Stewart-Warner Corporation, Chicago, Ill.: C. W. Hooper, J. E. Burke.
Union Parts Manufacturing Co., Brooklyn, N. Y.: Paul Nurkiewicz.
Weatherhead Co., Cleveland, Ohio: Frank Mettie, John Szitar.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. Wm. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.
Ammunition Division, Industrial Service: Col. F. H. Miles, Jr., Lieut. Col. Miles W. Kresge, Maj. A. D. Elliott, Lieut. G. H. Berlin, Jr., Dr. M. S. Falk, W. F. Stevenson.
District Control Division, Industrial Service: Lieut. Col. W. B. Becker.
Technical Staff, Industrial Service: Lieut. Col. K. F. Adamson.

Arsenal Representatives:

Picatinny Arsenal: A. F. Teitscheid, J. A. Taylor.

Ordnance District Representatives:

Boston Ordnance District: G. E. Crickard, J. Singleton.
Birmingham Ordnance District: Lieut. Col. W. F. Vander Hyden.
Chicago Ordnance District: Walter C. Krag.
Cincinnati Ordnance District: Lieut. J. J. Campbell.
Cleveland Ordnance District: Lieut. D. R. Imhoff.
Hartford Ordnance District: Maj. C. W. Vogt, Rex M. A. Fermier.
New York Ordnance District: Maj. G. I. Ross.
Philadelphia Ordnance District: John W. Ogden, Mr. Cosgrove.
St. Louis Ordnance District: Capt. Frank Marriott, Lieut. A. R. Burgess.

Ordnance Engineering Advisory Committees

10. Adapter and Booster Committee

Industrial Representatives:

Bohn Aluminum & Brass Co., Detroit, Mich.: James O. Wade, Arthur W. Reich, B. B. Brooks.

Chicago Roller Skate Co., Chicago, Ill.: Walter Ware, Gordon K. Ware.

Doehler Die Casting Co., Pottstown, Pa.: L. H. Pillion, J. J. Loughran.

Dollin Corporation, Irvington, N. J.: J. R. Schuchardt.

Electric Auto-Lite Co., Toledo, Ohio: C. W. Pound, C. F. Gilchrist, L. E. Koos.

Electric Household Utilities, Chicago, Ill.: J. R. Hurley, A. R. Nickson.

Emerson Electric Co., St. Louis, Mo.: W. S. Symington, J. A. Driy.

Federal Screw Works, Detroit, Mich.: F. M. Edgar.

Grigoleit Co., Decatur, Ill.: J. L. Howie, Jr.

Jesse Jones Paper Box Co., Philadelphia, Pa.: Frank Stone, J. W. McClenaghan.

Madison-Kipp Corporation, Madison, Wis.: T. E. Coleman, T. C. Korsmo.

Mueller Brass Co., Port Huron, Mich.: E. E. Sutter.

National Pneumatic Co., Rahway, N. J.: John R. Newkirk.

Robertshaw Thermostat Co., Youngwood, Pa.: G. P. Grace, H. T. Ryan (chariman).

Scovill Manufacturing Co., Waterbury, Conn.: M. L. Sperry, Jr., A. C. Lusher, P. A. Reutter.

Scripto Manufacturing Co., Atlanta, Ga.: E. P. Waite, C. E. Pittman.

Southern States Equipment Corporation, Birmingham, Ala.: Olan Richardson, Glen Mitchell.

U. S. Automatic Corporation, Amherst, Ohio: Eric Nord.

Warren Webster Co., Camden, N. J.: Orrin Dyer, James P. Hogan.

Westinghouse Air Brake Co., Wilmerding, Pa.: A. B. Fox, P. A. Bevan.

Wright Machine Co., Worcester, Mass.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. W. A. Borden, Lieut. Col. A. B. Domonoske, Maj. J. H. Frye.

Ammunition Division, Industrial Service: Col. F. H. Miles, Jr., Lieut. Col. M. W. Kresge, Lieut. D. K. Greenwald, W. F. Stevenson.

Technical Staff, Ammunition Division: Arthur Adelman.

Industrial Service, Production Division: G. B. Agnew, Jr.

Arsenal Representatives:

Picatinny Arsenal: W. H. Ewart.

Ordnance District Representatives:

Birmingham Ordnance District: Lieut. Col. W. F. Vander Hyden.

Boston Ordnance District: G. E. Crickard, J. Singleton.

Chicago Ordnance District: Arthur W. Clark.

Cincinnati Ordnance District: Lieut. J. J. Campbell.

Cleveland Ordnance District: Lieut. Myron K. Henderson.

Detroit Ordnance District: Joseph F. Morris.

Hartford Ordnance District: Maj. C. W. Vogt, Rex M. A. Fermier.

New York Ordnance District: Maj. G. I. Ross.

Philadelphia Ordnance District: Capt. A. Hamilton, John W. Ogden.

Pittsburgh Ordnance District: Capt. John H. Redmond.

Rochester Ordnance District: R. Harrison.

St. Louis Ordnance District: Forrest A. Moschner.

Other Engineering Advisory Committees yet to be organized on ammunition matériel will consist of representatives of manufacturers of the following classes of matériel:

11. Mechanical Time Fuze Committee

American Brass Co., Waterbury, Conn.; Crucible Steel Co. of America, New York, N. Y.; Doehler Die Casting Co., Pottstown, Pa.; Eastman Kodak Co., Rochester, N. Y.; Harvey Metal Corporation, Los Angeles, Calif.; Mueller Brass Co., Port Huron, Mich.; Scovill Manufacturing Co., Waterbury, Conn.

12. Loading and Assembly Committee

Elwood Ordnance Plant, Elwood, Ind.; Iowa Ordnance Plant, Burlington, Iowa; Ravenna Ordnance Plant, Ravenna, Ohio.

13. Chemical and Practice Bomb Committee

Bridgeport Thermostat Co., Bridgeport, Conn.; Edward G. Budd Manufacturing Co., Philadelphia, Pa.; Noblitt-Sparks Industries, Inc., Columbus, Ind.; Russakov Can Co., Chicago, Ill.

14. Fragmentation Bomb Body Committee

Edward G. Budd Manufacturing Co., Philadelphia, Pa.

III. COMMITTEES ON SMALL-ARMS MATÉRIEL

1. Small-Arms Weapons Committee

Industrial Representatives:

Buffalo Arms Corporation, Buffalo, N. Y.: C. E. Perkins, E. T. Allen, R. J. Black.

Colt's Patent Fire Arms Manufacturing Co., Hartford, Conn.: H. A. Stevens (chairman), G. Webb, C. H. Coles.

A. C. Spark Plug Division (General Motors Corporation), Flint, Mich.: W. C. Williams, P. W. Rhame.

Saginaw Steering Gear Division (General Motors Corporation), Saginaw, Mich.: A. W. Phelps, Roy Griffin.

Frigidaire Division (General Motors Corporation), Dayton, Ohio: E. G. Biechler, E. R. Godfrey, G. Auld.

Brown-Lipe-Chaping Division (General Motors Corporation), Syracuse, N. Y.: G. S. Cole, N. M. Ross.

High Standard Manufacturing Co., New Haven, Conn.: J. E. Owsley, G. S. Lewis, K. L. Ireland, G. S. Edwards.

Kelsey-Hayes Wheel Co., Detroit, Mich.: G. S. McIntyre, J. W. Pattison, J. C. Mahannah.

Remington Arms Co., Bridgeport, Conn.: E. C. Hadley, A. L. Lowe, P. B. Rutherford.

Savage Arms Co., Utica, N. Y.: G. N. Davidson, N. L. Brewer.

Winchester Repeating Arms Co., New Haven, Conn.: Edwin Pugsley.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. Wm. A. Borden, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: Col. T. J. Hays, Maj. W. J. Mason.

Small-Arms Division, Industrial Service: Lieut. Col. G. H. Drewry, Capt. M. L. Deguire, Lieut. J. M. Crews, Dr. S. G. Green, L. A. Carten.

Technical Staff: Maj. R. R. Studler.

Arsenal Representatives:

Springfield Armory: E. L. Wood, E. W. Hopkins.

Rock Island Arsenal: Lieut. Col. C. A. Waldmann.

Ordnance District Representatives:

Chicago Ordnance District: Lieut. Herbert E. Stier.

Cincinnati Ordnance District: Lieut. Col. Fred A. McMahon.

Detroit Ordnance District: Lieut. Col. Robert Sears, Maj. J. J. Breen, Lieut. M. W. Blackwood, J. Belsky.

Ordnance Research Advisory Committees

Hartford Ordnance District: L. A. Ricci, F. W. Hauff, Carl DeLeon.

Rochester Ordnance District: Capt. R. H. Coombs, Lieut. F. B. Lehner.

OPM Representatives:

Small-Arms Division: E. S. Chapman, J. G. Painter.

2. Small-Arms Ammunition Committee

Industrial Representatives:

Remington Arms Co., Bridgeport, Conn.: Col. W. L. Clay, E. C. Hadley (chairman).

Western Cartridge Co., East Alton, Ill.: Edwin Pugsley.

Winchester Repeating Arms Co., New Haven, Conn.: Edwin Pugsley.

Ordnance Office Representatives:

Office, Assistant Chief of Industrial Service, Engineering: Brig. Gen. G. M. Barnes, Lieut. Col. Wm. A. Borden, Maj. J. H. Frye.

Office, Assistant Chief of Industrial Service, Production: Fred Ayers.

Office, Assistant Chief of Industrial Service, Facilities: Capt. D. L. Van Syckle.

Small-Arms Division, Industrial Service: Lieut. Col. G. H. Drewry, Maj. W. T. Moore, Lieut. Ben H. Rawls, Frank Jervey.

Technical Staff: Maj. R. R. Studler, I. C. Gray.

Arsenal Representatives:

Frankford Arsenal: Lieut. Col. J. Kirk, Langhorn D. Lewis.

Ordnance District Representatives:

Chicago Ordnance District: Alfred R. Rose.

Hartford Ordnance District: Walter Reffelt, G. W. Forrester.

St. Louis Ordnance District: Capt. Frank Marriott, Lieut. F. P. Calabrese.

3. Small-Arms Equipment

(This committee probably will be formed into several subcommittees when the current production program develops further. So far no committees have been formed.)

Ordnance Research Advisory Committees

I. FERROUS METALLURGICAL ADVISORY BOARD

Industrial Representatives:

American Steel Foundries, East Chicago, Ill.: W. C. Hamilton.

Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.: Col. G. Elkins Knable.

Crucible Steel Co. of America, New York, N. Y.: F. F. McIntosh.

Henry Souther Engineering Co., Bridgeport, Conn.: F. P. Gilligan.

Midvale Co., Philadelphia, Pa.: Dr. H. L. Frevert.

National Bureau of Standards, Washington, D. C.: Dr. Lyman J. Briggs.

Republic Steel Corporation, Chicago, Ill.: R. S. Archer.

U. S. Steel Corporation, Pittsburgh, Pa.: Dr. E. C. Bain.

Youngstown Sheet & Tube Co., Youngstown, Ohio: A. C. Badger.

Service Representatives:

Watertown Arsenal, Watertown, Mass.: Brig. Gen. R. W. Case (chairman), Lieut. Col. S. B. Ritchie.

Wright Field, Dayton, Ohio: J. B. Johnson.

Naval Gun Factory, Washington, D. C.: Lieut. Comdr. Wallace S. Newton.

Bureau of Ordnance, Washington, D. C.: C. E. Margerum.

Frankford Arsenal, Philadelphia, Pa.: Maj. L. S. Fletcher.

Ordnance Office, Washington, D. C.: Maj. D. J. Martin.

The following are subcommittees formed under the direction of the Ferrous Metallurgical Advisory Board:

1. Subcommittee for Cast Armor

Industrial Representatives:

American Steel Foundries: W. C. Hamilton, C. G. Michelson.

General Steel Castings Corporation: R. A. Gezelius.

Continental Roll & Steel Foundry Co.: W. B. Libert, R. C. Heaslett.

Lebanon Steel Foundry: G. F. Landgraf.

Sivyer Steel Castings Co.: David Zuege.

Union Steel Castings Co.: C. N. Arnold.

Symington-Gould Corporation: W. J. Phillips.

Wehr Steel Co.: C. F. Wehr, A. T. Baumer.

Service Representatives:

Office, Chief of Ordnance: Maj. J. E. McInerney, Maj. J. H. Frye, Maj. W. J. Crowe.

Navy Department, Bureau of Ordnance: Comdr. G. C. Hoover, Comdr. C. E. Braine.

Aberdeen Proving Ground: Capt. J. L. Atkins, H. J. Rouse.

Rock Island Arsenal: H. A. Curtis.

Watertown Arsenal: Lieut. Col. S. B. Ritchie (chairman), Lieut. N. A. Matthews, Dr. E. L. Reed.

2. Subcommittee for Rolled Armor

Industrial Representatives:

Allegheny Ludlum Steel Corporation: V. B. Browne.

American Car & Foundry Co.: John Steinmeyer, G. L. Miller.

Carnegie-Illinois Steel Corporation: R. B. Cooney, M. W. Lightner.

Diebold Safe & Lock Co.: W. C. Miller.

Henry Disston & Sons, Inc.: R. T. Nalle, Roberts Sibley.

Republic Steel Corporation: E. C. Smith.

Service Representatives:

Navy Department, Bureau of Ordnance: Comdr. G. C. Hoover.

Office, Chief of Ordnance: Maj. J. E. McInerney, Maj. W. J. Crowe, Maj. H. A. Quinn.

Rock Island Arsenal: P. C. Cunnick, H. A. Curtis.

Watertown Arsenal: Lieut. Col. S. B. Ritchie (chairman), Lieut. N. A. Matthews, Dr. E. L. Reed.

Aberdeen Proving Ground: Capt. J. L. Atkins, H. J. Rouse.

3. Subcommittee for Welding of Armor

Industrial Representatives:

Republic Steel Corporation: E. C. Smith.

Carnegie-Illinois Steel Corporation: M. W. Lightner.

Henry Disston & Sons, Inc.: Roberts Sibley.

Diebold Safe & Lock Co.: W. C. Miller.

American Car & Foundry Co.: G. L. Miller, G. C. Beishline.

A. O. Smith Corporation: J. J. Chyle.

Baldwin Locomotive Works: A. J. Raymo.

Ordnance Research Advisory Committees

York Safe & Lock Co.: W. B. Lair.
Electro-Motive Corporation: J. H. Hruska.
American Steel Foundries: H. J. Shiffli.
Lebanon Steel Foundry: G. F. Landgraf.
Continental Roll & Steel Foundry Co.: W. B. Libert.
General Steel Castings Corporation: R. A. Gezelius.
Metal & Thermit Corporation: J. H. Deppeler.
Harnischfeger Corporation: W. V. Emery.
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Jessop Steel Co.: A. B. Cooper.
Simonds Saw & Steel Co.: E. A. Todd.
Youngstown Sheet & Tube Co.: G. A. Reinhardt.

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Railway Artillery

An Outmoded Element of Our Seacoast Defense?

Maj. Gen. Johnson Hagood*

MY REGIMENT, the 7th C.A.C. Railway, was the first of the heavy artillery to arrive in France and the first American regiment, I believe, to adopt the well-known Chinese motto "Can Do." The regiment made good. It was afterward broken up to form other regiments, but of the captains that went over with me one is now the Chief of Coast Artillery, one is a corps commander, while another, and also four of the five field officers, have so far been made brigadiers and major generals in the Regular Army. It is with no little regret, therefore, that I must reverse the old motto and now say that in my opinion railway artillery is of no material value for any purpose in the United States, and that all the time, energy, and money devoted to its development are wasted.

Ten years ago there was a movement on foot to bring about a disarmament conference. It was stated in the public press that the then Chief of Staff, Gen. Douglas MacArthur, had suggested to President Hoover that America make the first move by offering to give up all "offensive weapons" including the heavy mobile artillery; that is, all railway artillery, the 240-mm. motorized howitzer, and the 6-inch G.P.F. —retaining only the fixed guns of the seacoast fortifications, the 6-inch howitzers, and the 3-inch field pieces.

I asked General MacArthur one day in his office why he had made such a recommendation. I was seated near his desk, and he as usual was pacing the floor. He went over to the window and, after looking out for a few moments in silence, turned suddenly and said:

"For two reasons, Johnson: first, because I know that none of the other nations will accept such a proposition; and second, because you know, and I know, that none of this heavy mobile artillery will ever be of any value to the United States."

"Yes," I replied, "I know it, but I did not know that you knew it."

"That," he said with his characteristic and irresistible smile, "is where I had the advantage of you. I knew that you knew it; but you did not know that I knew it!"

How much weight, if any, should be attached to such an opinion expressed by General MacArthur—an Engineer officer? Most of our Chiefs of Staff (and I have known them all) have had very little first-hand knowledge of any branch of the Army except their own. They are, *ex-officio,* the mouthpiece of civilian Secretaries of War, and their opinions as publicly expressed are usually those "of the Department." They almost invariably reflect the views of the General Staff, composed of men who prepare "studies" upon subjects of which the chiefs themselves have little or no first-hand knowledge.

Douglas MacArthur was one of the few exceptions to the rule. Among the fifteen men who have served in the office of Chief of Staff since it was established in 1903, he is one of the few whose opinion on military matters can be taken as that of an expert.

*Author: "The Services of Supply," 1927; "We Can Defend America," 1937; numerous professional papers and articles in popular publications. Major General, U. S. Army, Retired.

Let me stand, therefore, with General MacArthur and try to qualify as a witness upon this particular question. And let those who hold a contrary opinion do the same.

RAILWAY artillery was first used during the Civil War when, at the suggestion of Gen. Robert E. Lee, a battery mounted upon a flatcar was constructed by the Confederate Navy. It carried a single 32-pounder gun and was protected by an armor of iron rails as was the famous warship Monitor. This gun could fire from the tracks without any special preparation and was sufficiently mobile to take up into position in a railroad cut near Savage Station and enfilade the enemy's infantry. It was, in fact, a forerunner of the modern heavy tank. Later, a battery of 13-inch mortars mounted on flatcars was used by the Federals in the Siege of Petersburg.

Forty-odd years later, Maj. Gen. Arthur Murray—America's greatest authority on coast defense—proposed the use of railway artillery in the defense of the Hawaiian Islands. His plan was to have permanent tracks laid to strategic points around the island of Oahu, where 12-inch seacoast mortars mounted upon cars could be brought to bear upon enemy transports and light-draft warships attempting to force landings outside the zone of the permanent fortifications. The distances on the island were very short, the positions could be prepared in advance, and, in an hour or two at most, all the mortars could be brought up and put into action.

We can see now that this form of bombardment is a function of the airplane and that the value of railway artillery for such a purpose, even in a place like Honolulu, would be slight. But seacoast mortars, however they may be emplaced, are not suited for use against land targets or against landing parties. This was tested out in a long series of experiments in the Philippine Islands conducted under instructions from the War Department by the Defense Board of which I, as coast-defense officer on the staff of the department commander, was the secretary and working member. The guns of Corregidor were fired at targets on the slopes of Mareveilles across th· bay. And correspondingly mobile guns, landed from the sea, fired live ammunition against the batteries and searchlights on Corregidor from which the personnel and breakable parts had been removed and temporarily replaced by dummies.

The high-explosive shells of the landing force had no difficulty in reaching their targets on Corregidor. But the guns and mortars on Corregidor could not locate the constantly changing positions of the "enemy" in the deep valleys and ravines of Mareveilles. Moreover, the heavy seacoast projectiles sank deep into the ground and did no material damage. We then tried shrapnel, but the time of flight (from fifty to sixty seconds) could not be predicted with sufficient accuracy to set the fuzes. Here again the answer is "Airplanes."

I have never been stationed in the Hawaiian Islands, but I have been over the defensive lines a number of times with

Signal Corps Photo

A 14-INCH RAILWAY GUN SPEAKS FOR SEACOAST DEFENSE

members of Congress, department commanders, Engineer officers, Coast Artillerymen, and others on the ground, and I discussed the plans with the president of the board of officers that drew them. There can be no question but that the objections we developed in the Philippines to the use of seacoast guns for land defense, whether on railroad mounts or otherwise, would apply equally to Honolulu.

THE Philippine experiments were conducted in 1913-1914. Two years later I was on duty with the South Atlantic Coast Artillery District with headquarters at Charleston, S. C., and there was submitted to us a plan of defense known as the Haan-Wotherspoon Plan. It proposed five infantry divisions for the defense of a 12-mile strip of beach running south to Pamlico Sound from Cape Henry, on the south side of Chesapeake Bay. This is in effect the only stretch of open mainland beach from Chesapeake Bay to the Rio Grande River. With a few unimportant exceptions, all other beaches are on islands separated from the mainland by open water or impassable marshes.

In my report on this plan, it was shown that such a defense by infantry was impracticable—even if the five infantry divisions ever could be mobilized and ready when needed—but that with a proper system of fortifications prepared in advance, 2,000 men could hold off all comers indefinitely. The suggestion was made that the line of sand dunes back of the beach be supplemented by a ditch and an embankment thrown up by an ordinary canal digger and along which would be installed seacoast guns, machine guns, searchlights, range finders, and other such necessary equipment. This was to be supplemented by railroad tracks with alternate permanent emplacements into which heavy railway artillery could be rapidly concentrated.

My plan never got beyond department headquarters, but we can see now that, as in the case of Hawaii, the function assigned to the railroad artillery here could best be performed by airplanes. Moreover, there is no other place on the coast of the United States from Maine around to Seattle where railway artillery could be used to any greater advantage.

During the latter part of the World War, the Germans had a similar situation on the Belgian coast. There was a short stretch of beach from Zeebrugge south to Ostend back of which was a naval base at Bruges, corresponding somewhat to our naval base at Norfolk. The Germans mounted permanent seacoast batteries along the line of sand dunes and back of that brought up three batteries of 15-inch railway guns. These guns, however, having once been put in place, remained there to all intents and purposes as fixed batteries until the end of the war.

I did not command any railway artillery at the front in France as I was transferred to other duty, but I saw all calibers of both French and American railway guns in action, and after the Armistice I was assigned for a short time to the command of the 30th Railway Brigade and was sent over back of the German lines to investigate and report upon the damage done by our heavy guns in the Verdun sector, especially by the 14-inch naval guns.

UPON my return to the United States in the following May, I again was assigned to the command of the 30th Brigade and to the command of Camp Eustis, Va., where all the railroad artillery in the United States had been collected. This included the 14-inch naval guns, the 12-inch seacoast mortars, the 8-inch seacoast rifles, and a number of foreign guns of 7-, 10-, and 12-inch calibers on various types of sliding mounts. There were four regiments of railway troops, all of which had seen service on the Western Front. There also was one 14-inch American gun on a new seacoast railway mount at Fort Story, Va. (Cape Henry). This battery had been placed there for experimental purposes by the Coast Artillery Board, but the troops of my command operated it.

During the period of more than a year that I was in command at Camp Eustis, we conducted firings with all calibers of railway artillery both at land and at water targets, and I was called upon then and later to submit many reports and

recommendations upon various phases of this question.

Among the plans which came under my consideration were: (1) A plan to establish a school for Army locomotive engineers and brakemen, in connection with the C. & O. Railway shops at Richmond; (2) A plan to run strategic railways around the perimeter of the United States near enough to the coast to be used for the purpose of coastal defense; (3) A plan to establish a railway artillery center at Pittsburgh, or some similar location where all the railway artillery at Camp Eustis could be permanently transferred and held in readiness to be rushed to the point of attack in case of emergency.

All these ideas, and others under consideration then and later, I regarded as fantastic. No garrison-schooled Regular Army soldier would be allowed to run a locomotive with a train of cars through any civilized country, nor is there any such shortage of locomotive engineers as to suggest that the Army should use the taxpayers' money to train some. The railroads of the country already run as close to the coast as they can get; and it took us about three months to send a single gun and carriage to Pensacola, Fla., for some experimental firings, because of the bridges and tracks that would not support the load.

We tried to conduct some long-range experimental firing with the 14-inch railway gun at Fort Story. A large party of Congressmen, generals, admirals, and others came down from Washington to see it. The Navy had loaned us a destroyer to tow a huge target provided for the purpose. However there was a slight haze over the bay into which destroyer and target soon disappeared. So that was the end of that: the distinguished guests were treated to the usual honors and ceremonies; they were regaled with a home-cooked luncheon of Army beans, but they never heard the sound of a shot!

IN ORDER to try out the visibility of long-range water targets under ordinary conditions, I ran a series of daily tests of a year or more each—one at Corregidor (1913-1914) with Lewis depression range finders at an altitude of 630 feet; one at Lee Hall, Va., near Camp Eustis (1919-1920) with captive balloons at altitudes suited to the conditions; and one in New York (1924-1925) using the Lewis range finders at Fort Hancock, N. J. and the airplanes from Mitchel Field, Long Island, which had been placed at my disposal for that purpose by the War Department.

It was shown that while the Coast Artillery could select occasional days that were favorable to long-range practice, the usual day-in and day-out conditions were such that commercial ships moving in and out Manila Bay, Chesapeake Bay, and New York Harbor could not be picked up and located with sufficient accuracy for targets at ranges of more than ten or twelve miles—never at twenty miles. On the Pacific Coast, especially in California, the conditions are very much worse on account of fogs. At night and in thick weather the ranges might be reduced to zero at any of our permanent seacoast forts. For railway artillery, with its crude apparatus, to attempt to hit ships in motion upon the open sea is a hopeless task.

One of the 14-inch railway guns that I had at Camp Eustis, or a similar one, is now at Fort MacArthur out on the Pacific Coast. When I was there a few years ago with a party of Congressmen, it was perched on top of a ridge like the monument at Bunker Hill. The commanding officer said he had no ammunition and that there was a scheme on foot to take it off the hill and install it in a permanent emplacement.

When we speak of railway artillery, we mean only two things—the type of carriage and the tracks. The guns are all the same. Some came from battleships, and some came out of forts, and it is manifest that any such guns, weighing from fifteen to a hundred tons, and mounted in any such way, could be used only in some form of stabilized warfare—something in the way of siege operations either on the land or from the sea.

FOR land warfare in the United States, railway artillery could be used only to bombard and destroy our own cities and our own bridges and utilities after they have been captured by an enemy. No such situation could be brought about except through the grossest neglect and inefficiency on our part, and I, for one, am unwilling to accept a system of national defense that admits of any such contingency. Maj. Gen. Omar Bundy is alleged to have said, "My men would not know how to retreat"; God forbid that any American soldier should ever be trained to destroy New York City!

When it comes to seacoast defense, there is only one excuse for railway artillery and that is the excuse of economy. The claim is made that it would be cheaper to provide a small number of railway guns that could be shifted from place to place than to provide a greater number of guns in fixed positions. But considering the total inadequacy of such a defense, the cost of the Navy, and the tremendous cost of a mobile army prepared to operate against an invader after he has effected a penetration, it would be better and cheaper in the long run to spend twenty times as much to provide a proper system of permanent seacoast fortifications than to put our trust in a precarious system of run-about artillery, that we know in advance will fail.

Railway artillery requires too much time to put into position. Even in the piping times of peace, in shipping just a few guns here and there with plenty of time at our disposal, we have developed all kinds of trouble in crossing bridges, in going through tunnels, and in clearing railroad stations and other obstructions too near the tracks.

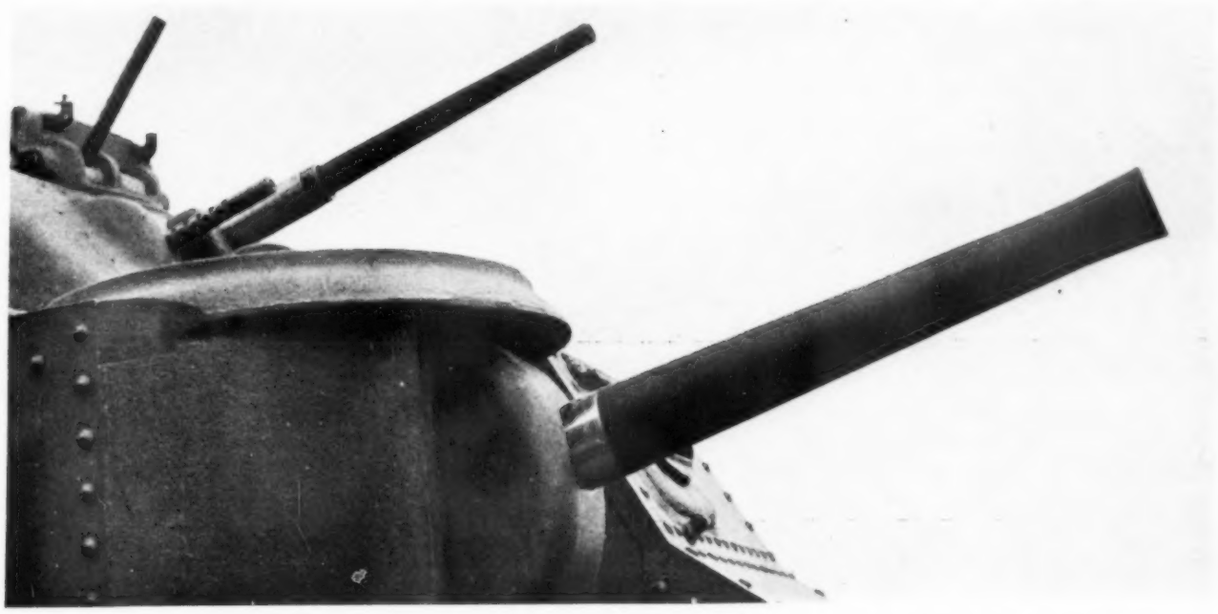
Ships at sea present very small and very difficult targets constantly in motion. For the use of long-range guns it is necessary to have an extremely accurate and rapid system of fire control or, as in the case of the Navy, a tremendous volume of salvo fire from guns of the same caliber. The railway artillery is provided with neither and must depend upon field methods for range finding and upon very crude methods of loading, with a correspondingly slow rate of fire. Four shots in ten minutes was reported as good from an 8-inch gun at the time I was at Eustis, and no material improvement has been made since; that is, nothing comparable to the advances made by the Navy, the Field Artillery and the Air Corps.

The newspapers recently pictured an 8-inch gun on a new railway carriage. It is said to throw a 260-pound projectile 18 miles. The 8-inch gun was discarded for coast-defense purposes more than thirty years ago. Its projectile could not pierce the battleship armor even of that day at any practical ranges, and its striking energy as compared with that of a modern 12- or 14-inch gun, to say nothing of the 16-inch, is like that of an ordinary carpenter's hammer compared with the sledge of a blacksmith.

This whole railway-artillery business is just something that recently has been disinterred after a long period of rest. It should be reburied again as quickly as possible.

Industry at Arms

THE industrial phase of our armament program, which really got under way last September, is finally beginning to produce results—not in hundreds of guns and tanks and airplanes—these will come later—but in gages and tools and machinery and plants. It takes at least a year to convert private industry to manufacture military armament. That year is nearly over. New plants have been built. Machinery has been installed. Steam is up. Wheels are now beginning to turn—slowly at first—but by the end of summer mass production of many items of armament will be a reality. Another six months and industry will have built up a mighty arsenal for the men of America.



An outstanding example of this industrial conversion is the Army's new M3 medium tank. This 28-ton fighting machine is a weapon of speed, maneuverability, and great fire power. It is armed with a 75-mm. cannon, a 37-mm. high-velocity gun, and a number of machine guns. It is the backbone of the Army's new Armored Force. This new weapon is described by Lieut. Col. John K. Christmas, Ord. Dept., in an article on page 27 of this issue.

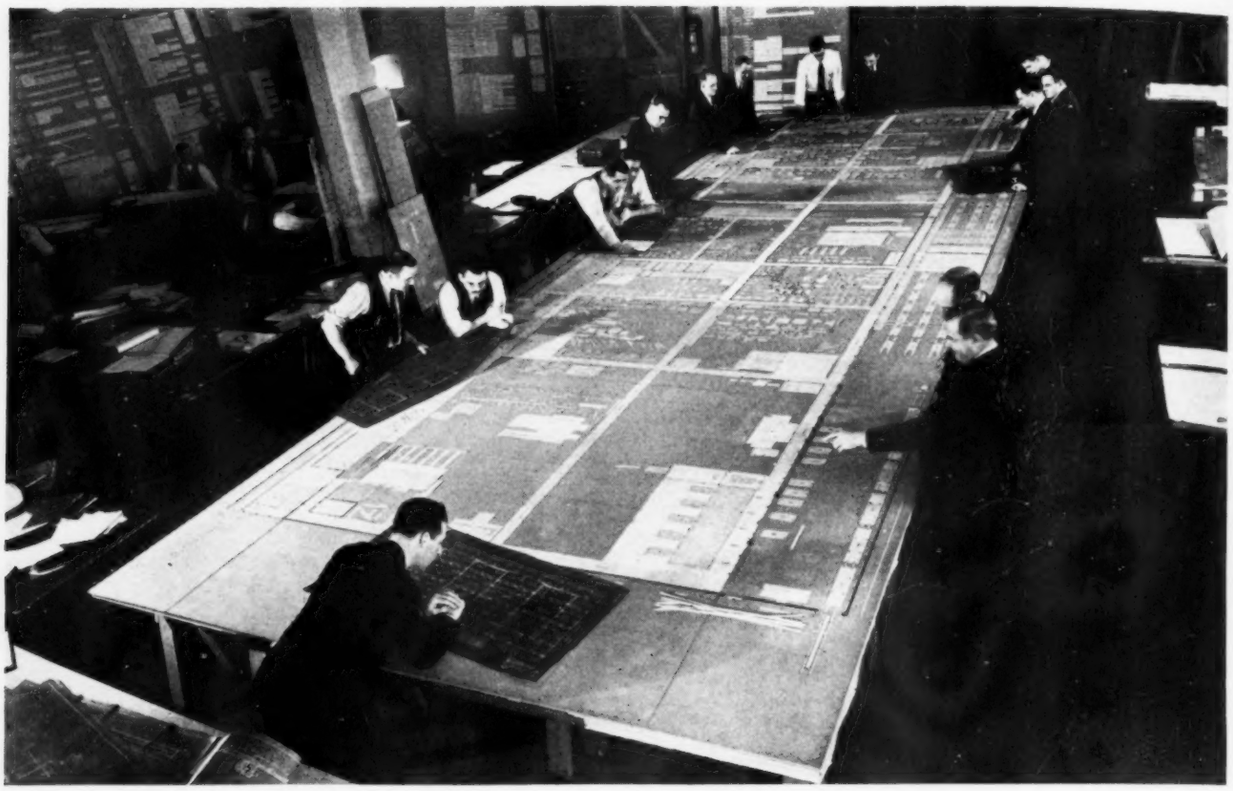
To private industry has been given the task of producing this tank in quantity. Three companies will manufacture it—the Chrysler Corporation, the Baldwin Locomotive Company, and the American Locomotive Company. Present tank orders with these companies total nearly $110,000,000. The American Locomotive Company was awarded its contract on November 23, 1940; less than five months later it successfully tested and turned over to the Government its first tank. Before this, however, 200 machine tools were ordered; thousands of square feet of floor space at the Schenectady (N. Y.) plant were rearranged for a rapid tank-assembly line; over 2,500 drawings were processed; 350 subcontracts for materials were placed; hundreds of new workmen were hired and trained. The Baldwin Locomotive Works effected a similar rapid conversion for M3 manufacture at its Eddystone (Pa.) plant. This company is also making 37-mm. gun tubes and 8-inch railway guns.

To the Chrysler Corporation, however, fell the task of producing the major portion of the new tanks and the world's first tank arsenal. On August 15, 1940, the corporation received a Government contract to build and equip a $20,000,000 permanent tank arsenal. Less than a month later, ground was broken on the site—near Detroit—and on April 12, 1941, the first pilot tank was completed. It was delivered to the Government on April 24th.

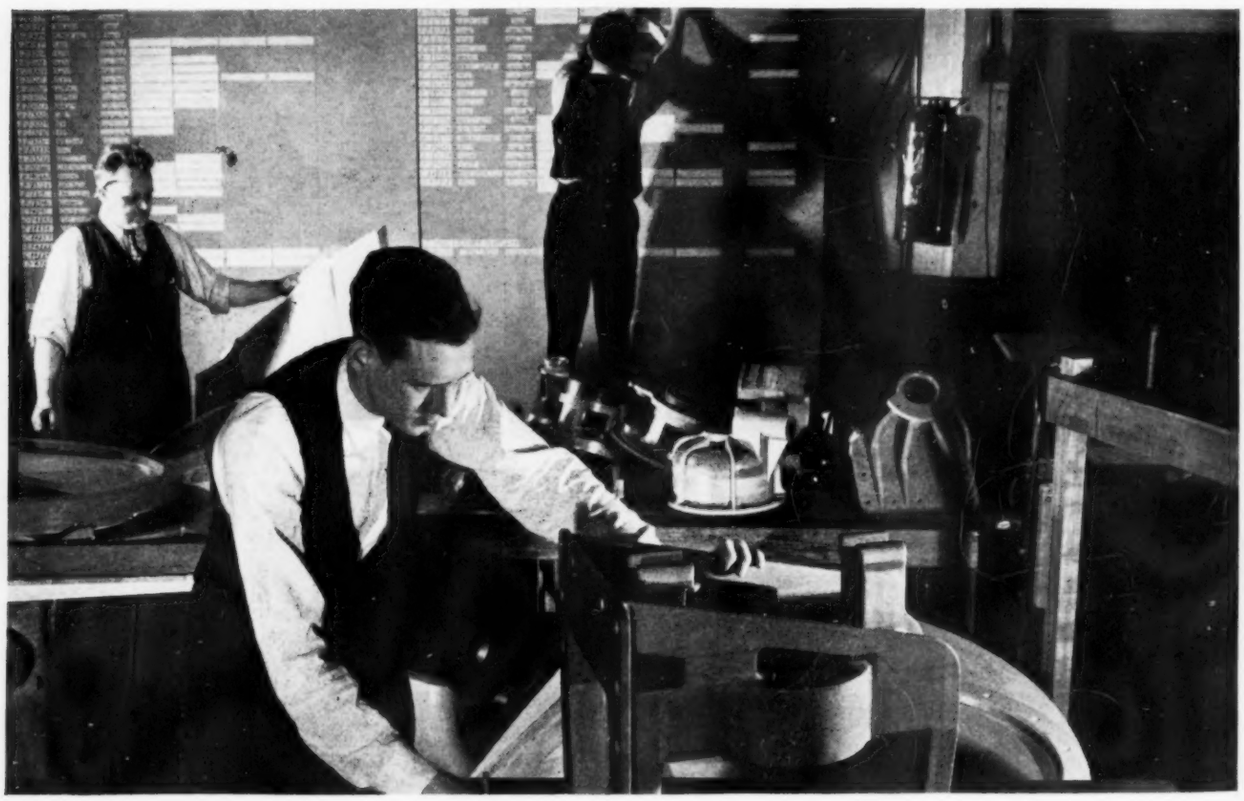
The Chrysler Tank Arsenal covers 700,000 square feet, is 5 city blocks long and 2 wide. Over 6,500 tons of steel were used in its construction. More than 10,000 workers will be on the job by the end of summer.

At long last, after months of planning and labor, industrial America is nearly ready to go into mass production of military armament for the defense of the United States.

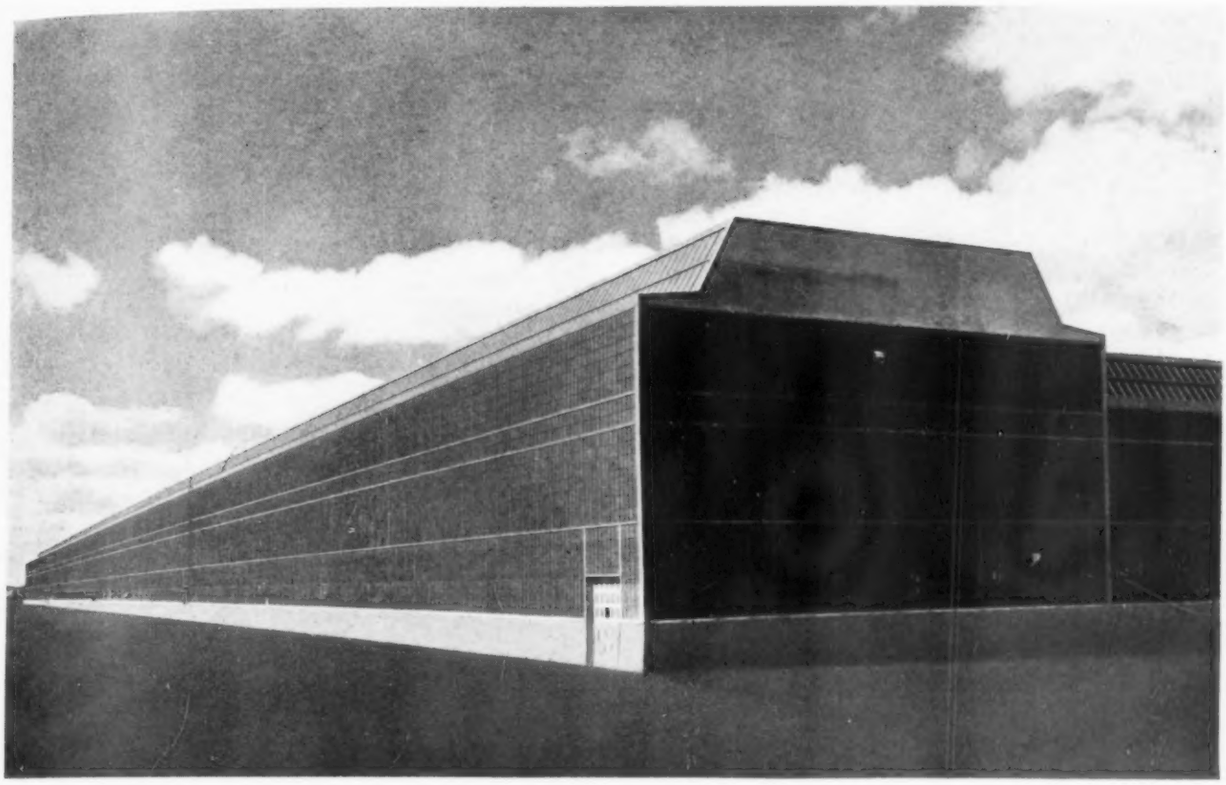
Planning New Tank Production



Chrysler engineers, above, develop the layout of the new arsenal for mass production of the medium tank M3. On the final assembly line, 66 tanks will be in process at one time. Materials are brought in at one end of the plant and the finished tanks shipped by freight car from the other. Below, Chrysler production men study wooden models of heavy tank castings.



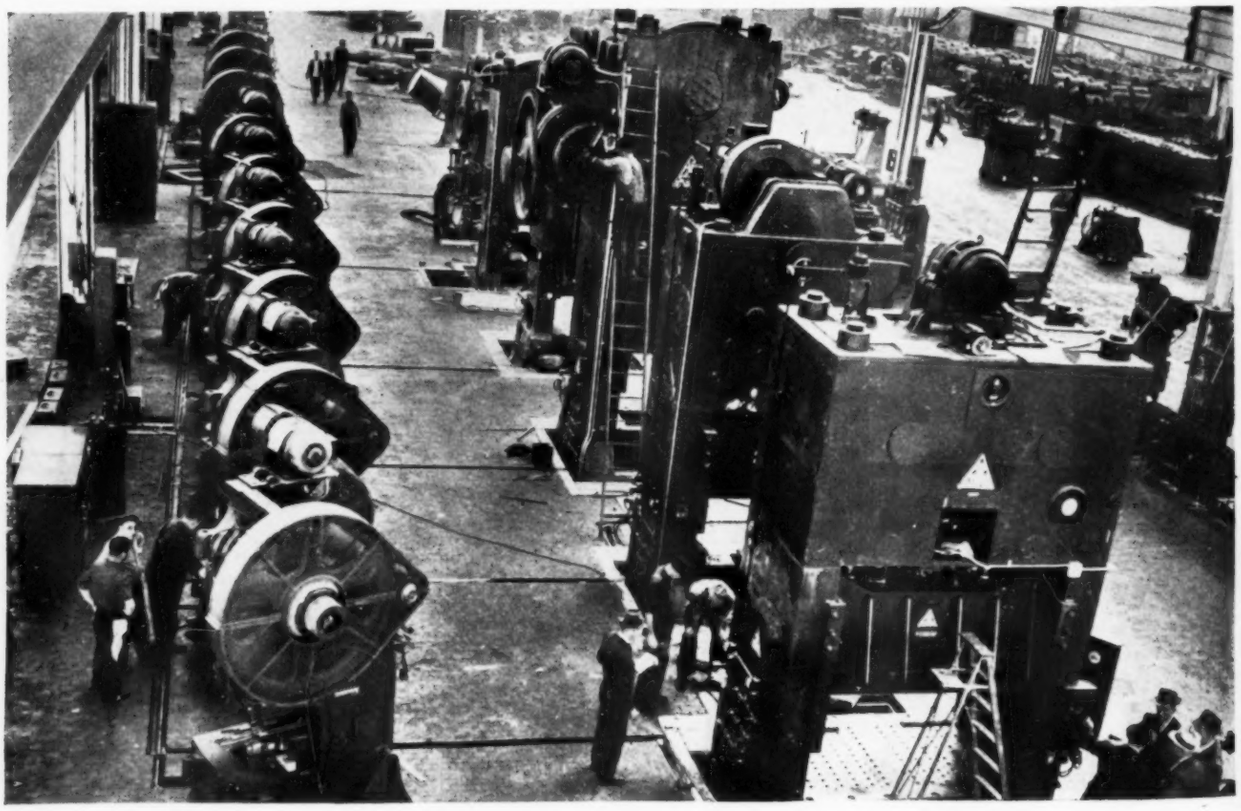
The Chrysler Tank Arsenal



The Chrysler Tank Arsenal at Detroit, above, is 1,380 feet long and 500 feet wide. Its 80,000 panes of glass cover an area of 6½ acres. Below, the wooden models of intricate castings for the medium tank serve as a guide to Chrysler engineers and manufacturing experts in planning machines and processes for fast mass production of the 28-ton armored vehicle.

New Lines by Chrysler

The first of the new medium tanks is shown above leaving the Chrysler Tank Arsenal for its trial run. This first tank was paid for by contributions of Chrysler employees and presented as a gift to the U. S. Army. The view inside the arsenal, below, shows rows of machines being installed on the production line. By late summer, all wheels will be turning.

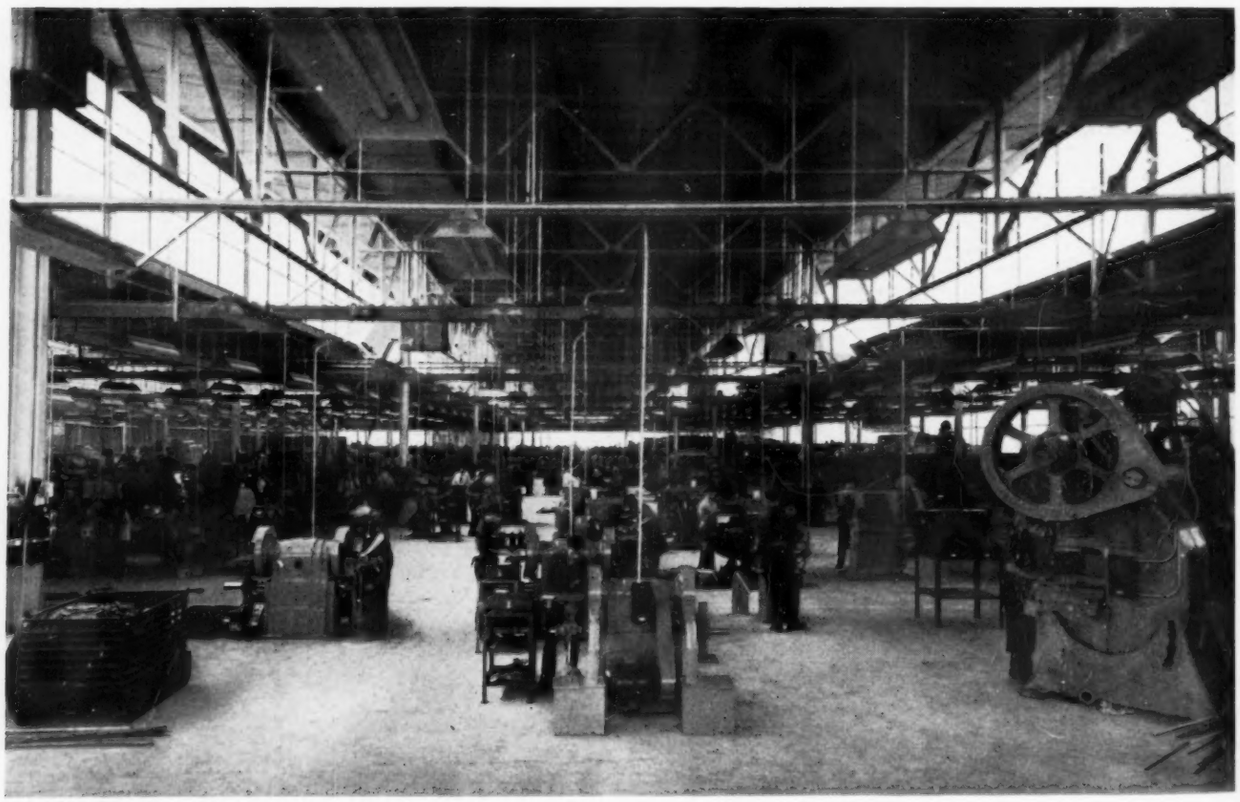


First Products of the New Tank Arsenal

Above are the first two tanks produced at the Chrysler Arsenal. They were received for the Army by Maj. Gen. C. M. Wesson, Chief of Ordnance (left), from K. T. Keller, Chrysler Corporation president (right), after appropriate ceremonies at the arsenal. Equipped for combat duty, one of the new vehicles is shown below demonstrating its strength.

More New Ordnance Production

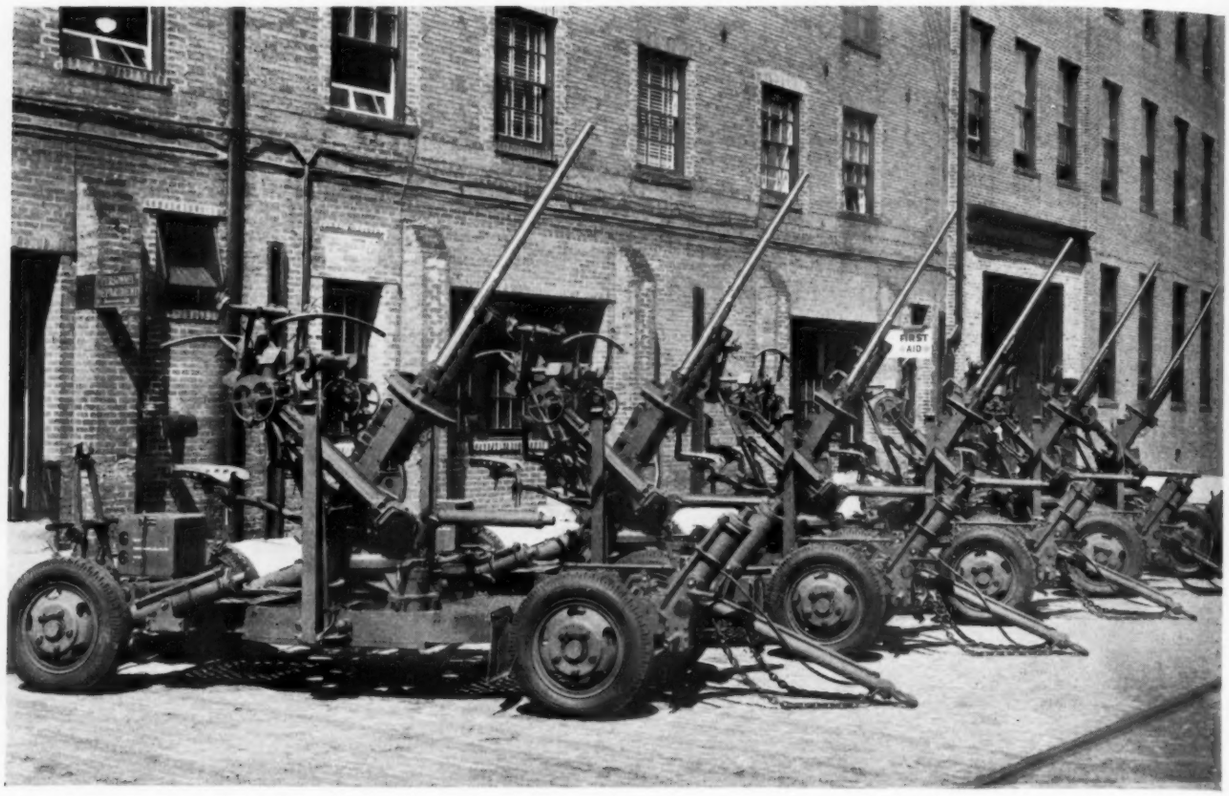
The Baldwin Locomotive Works is also manufacturing the new medium tank at its plant at Eddystone, Pa. Its first completed vehicle is shown above at the plant. Wheels are turning also at the 5-acre machine-gun plant of the Saginaw Steering Gear Division of General Motors, at Saginaw, Mich., shown below manufacturing caliber .30 Brownings.



More Tanks—Light and Medium

The light tank also holds an important place in our military program. The American Car & Foundry Company is turning out hundreds of these machines armed with a 37-mm. gun and several machine guns, like those shown above at the Berwick (Pa.) plant. Below is shown another M3 medium tank—this one made by American Locomotive Company.

Air Defense and Attack



Air defense and attack are major considerations in industry's rearmament effort. Above are 37-mm. antiaircraft guns on carriages manufactured by the Bartlett Hayward Division of the Koppers Company at Baltimore, Md. Harrisburg Steel Company is making 100- and 500-pound aircraft bombs for the Army—part of its 100-pound bomb line is shown below.

FIG. 1. THE NEW SCOUT CAR, M3A1

The Modern Scout Car

A New Armored Vehicle of Increased Fire Power and Mobility

Charles Hiller, Jr.*

THE combination of mobility and fire power long has been a military ideal. In modern warfare, to "get there first with the most men" means little unless one also gets there with the most guns—with the greatest fire power. However, these two long-sought qualities—mobility and fire power—have, until recent times, seemed impossible of combination.

For mobility means speed over surfaced roads and the ability to travel across difficult terrain, including soft ground, steep hills, ruts, ditches, and underbrush. In brief, it means going where the tactical situation demands—quickly. On the other hand, fire power implies large supplies of ammunition, a great number of guns, and sufficient men to fire and service them. This seemed to require units of considerable size and weight—the very antithesis of mobility.

It remained for the era of mechanization and motorization to reconcile these characteristics and combine mobility and fire power into efficient combat units, driven by motors with the strength of a hundred horses, dashing over roads at high speeds, charging across country, delivering devastating fire from deadly machine guns. The fighting tank and the armored scout car are outstanding examples of this modern synthesis—the former for attacking hostile strong points and destroying enemy communications, the latter for rapier-like raids and reconnaissance. It is the scout car which we will consider in detail in this article.

Prior to the advent of the automobile, the horse cavalry was the most mobile unit of the Army. Its mission was that of rapid attack and reconnaissance to obtain information as to the location and strength of the enemy. Shortly after the outbreak of the World War, the need was felt for a fast-moving armored vehicle, for operation on the highway but with some cross-country mobility, and there appeared in the various armies of the world the predecessor of the modern scout car—the armored car. This vehicle had a considerably longer radius of operation than the horse—being capable of traveling approximately one hundred miles without refueling, and it offered infinitely greater protection to the men inside than could be had by a man on a horse. Figure 4 shows the first armored car designed and built for the U. S. Army. The armored car, however, was comparatively heavy and did not possess the general mobility of the horse for cross-country operations. The need was felt, therefore, for a car of little weight and great mobility—one that could supplant the horse in many tactical situations.

AS a result, the first modern scout car was designed in 1928. This vehicle consisted of the chassis of a medium-priced commercial automobile equipped with oversize tires to give greater flotation over soft ground and greater riding ease over rough terrain. This car offered no more protection than was afforded the soldier on horseback, except that the men in the front seats were protected by an armor-plate windshield. The car was equipped with two double bucket-type seats mounted as close to the chassis frame as practicable, and armament consisted of one machine gun mounted on a universal bracket on the windshield and operated by the assistant driver who occupied the right-hand front seat. The radiator and engine were protected by an armor-plate radiator shield.

This was a highly mobile vehicle and could operate over very rough ground, through mud and water, and had a cruising range of from 155 to 175 miles without refueling. The maximum speed of the car was about 45 miles an hour

*Ordnance engineer, Industrial Service, Office of the Chief of Ordnance, Washington, D. C. Captain, Ordnance Reserve, U. S. Army.

and, should the going get too bad, was light enough so that members of the crew could assist by pushing—as was sometimes necessary with the lower-powered engines of that day. After extended service tests with vehicles of this type, the need of still greater cross-country mobility, more guns, and greater protection for the crew was felt.

Various types of armored cars were then built and tested, and in 1931 the armored car M1 was manufactured (Fig. 6). This was a 6-wheel car with the four rear wheels driven, completely armored, and capable of a maximum speed of fifty-five miles an hour. This car carried a crew of four men and was armed with one caliber .30 machine gun and one caliber .50 machine gun, mounted in a revolving turret. The cruising range was about 250 miles before refueling was necessary. While an excellent vehicle, this model had one serious defect—poor operating and combat visibility for the crew.

Fig. 2. The Front Roller Enables the Scout Car to Cross Deep Ditches

About two years later, the mechanized cavalry set up a requirement for an open-top vehicle with great cross-country mobility, offering the maximum protection for the crew without impairing visibility and having a greater number of guns than were heretofore mounted on an armored car. As the result of these requirements, it was decided that an all-wheel-drive commercial truck chassis should be used as a basis for mounting the armor-plate body. The Indiana 4-wheel, 4-wheel-drive, 1½-ton truck chassis was selected as ideal for this purpose, and an armor-plate body was designed for it by the Ordnance Department (Fig. 5).

Fig. 3. Seating Arrangement of the New Scout Car

THE first armored scout car, from which the present scout car was evolved, was thus created. This car carried a crew of 4 men, weighed approximately 4½ tons, and was capable of a maximum speed of 50 miles an hour. The car carried two caliber .30 machine guns mounted on the sides of the body operated by the men in the rear seats, and one caliber .50 machine gun mounted on a pedestal on the right-hand running board. This gun could be fired from behind the open right-hand door which thus provided a shield for the gunner. The radiator was protected by armor-plate shutters which could be closed when the vehicle came under enemy fire. The car was equipped with an extensible trunk on the rear where the crew could stow their packs and other necessary baggage required for long runs away from the remainder of their organization. This car also was equipped with radio apparatus for 2-way communication for receiving orders and reporting enemy movements, road conditions, etc.

The next development, the scout car M2, was very similar to the scout car M1 except that the commercial truck chassis was abandoned and a special frame of the "double-drop" type was adopted. The vehicle was designed to carry a crew of from five to seven men, depending on the type of service required, and the maximum speed was increased to fifty-five miles an hour. Both the scout car M1 and the scout car M2 were capable of a run of approximately 200 miles without refueling.

Long and strenuous service tests and maneuvers proved this type of car the ideal vehicle for scouting work. These cars had great cross-country mobility, good visibility for the crew, speed on the main highway, and long-range operation without the need of supporting supply trucks. Thus a party on a scouting expedition could make long encircling marches and report their findings to headquarters by radio. The vehicles had sufficient guns and fire power to fight off a small detachment of enemy scouts and offered reasonable protection to the crew.

THE next step in the development of the scout car was to provide greater crew comfort, greater protection, and greater cruising range. The first two vehicles had engine hoods which were too high to give the best visibility to the drivers when going over uneven ground, and steps now

were taken to correct this defect. In 1937, the Ordnance Department undertook the complete design of a new scout car using as many components as possible which were commercially available. A special double-drop frame was designed, and a body was developed to meet the exact needs of the mechanized cavalry. The radiator of the car was built low and wide, thus making the hood low in front so that the driver could more readily see the ground directly ahead —a condition highly desirable in cross-country operation.

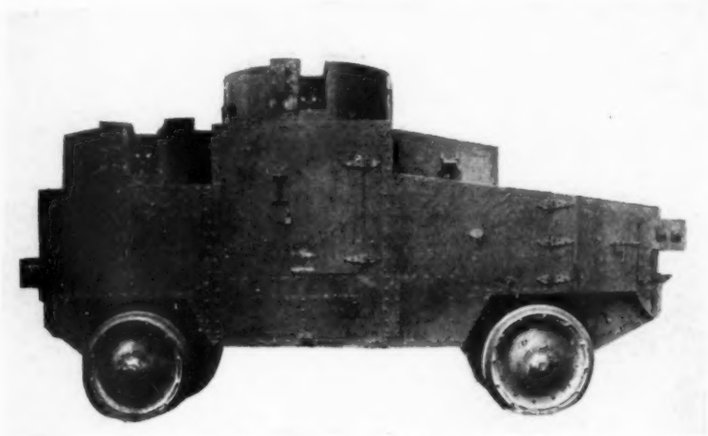


FIG. 4. THE ARMY'S FIRST ARMORED CAR, 1915

A new gun mount, known as the Tourelle type, came into use on this vehicle. It consists of an I-beam-shaped track mounted around the top edge of the body just inside the armor plate. On this track runs a carriage, or skate mount, bearing the machine gun which may be readily moved to any position on the track and locked in place.

The scout car M3 (Fig. 7) weighs approximately 5 tons, fully loaded, has a maximum speed of 55 miles an hour, carries a crew of 8 men, and is capable of being operated a distance of approximately 250 miles without refueling. Three machine guns are mounted on this vehicle and all vital parts are protected by armor plate.

Step by step, the scout car has undergone development. Each succeeding model was made capable of carrying an increased load of men and supplies and could travel greater distances without refueling. Engine and part makers had steadily improved their products—more power being obtained from a given engine and longer life from such parts as axles and transmissions. In other words, steady progress had been made all along the line with the result that more reliable vehicles had been obtained from the manufacturer. However, one or two shortcomings still remained. First, when fully loaded and equipped, the crew members were quite cramped for space; secondly, when crossing ditches with very steep banks, the front end of the scout car would often come up against the far side of the ditch and the front wheels would be hung clear of the ground with the front bumper nosed hard into the bank. The only way to remove the vehicle was by use of a tow cable.

To remedy these defects, designs were started on a new and improved scout car early in 1939. This model was to be known as the scout car M3A1 (Fig. 1). Using a chassis very similar to that of the scout car M3, stress was laid on the proper seating of the crew members to give the maximum comfort for a vehicle of this type. The body was widened so that the rear wheels operated in wheel housings rather than under fenders, as in previous models. Foot wells were built into the vehicle in front and back of the rear wheels. The crew was arranged so that some members of the crew were looking out of each side and each end of the vehicle. The driver and the car commander were placed in the front seats of the vehicle and the radio operator and an assistant, or gunner, back to back just aft of the front doors of the car. The next two men were located so that they face the rear of the car, and the last two men sit at the rear of the car facing outward (Fig. 3). This seating arrangement uses the entire space of the car to the best advantage. Ammunition is carried in built-in boxes over the wheel housings and in a box fixed between the two front seats.

The Tourelle-type gun mount is retained, and the vehicle is armed with three machine guns. The gun cradles are so designed that for ground fire they can readily be removed from the carriage or the track and fitted into a tripod carried on the back of the car. Thus, a machine-gun troop may be transported rapidly to the front, may dismount and unload the vehicle and be ready for ground action in a short time—the vehicle being driven to a place of greater safety. For scouting work the guns are carried in their Tourelle mounts and are ready for instant action against ground troops or low flying aircraft.

ANOTHER improvement in the scout car M3A1 over its predecessors is its ditch-crossing ability. In place of the bumper, a steel roller is mounted on the front of the car.

FIG. 5. THE FIRST FULLY ARMORED SCOUT CAR, M1

This roller is free to revolve and is the same width as the frame of the vehicle. In crossing a ditch which would ordinarily catch the front bumper and stall the car, the front

roller comes into use. This roller is sufficiently strong to support the front part of the car, and the vehicle is driven forward with power from the rear wheels until the front wheels hit solid ground and gain traction (Fig. 2). Scout cars of all models have now been provided with all-wheel drive.

The scout car M3A1 has a gross weight, fully loaded and equipped, of about 5¾ tons and a maximum speed of approximately 55 miles an hour on the highway. Commercially available deep-grip tires are used to give maximum cross-country mobility. One of the most interesting features of the scout car M3A1 is the seat cushion. This cushion consists of a canvas envelope fitted with a zipper and having a sheet of sponge rubber built into one side. The remainder of the envelope is filled with the soldier's blanket, shelter-half ropes, and tent pins. Thus, the soldier sits on one of the bulkiest parts of his pack and the interior of the car is kept clear for action at all times.

Before a scout car is manufactured in quantity, a pilot vehicle is always built. This car is constructed of soft steel instead of armor plate in order that minor changes may be made either to suit the ideas of the using service or to facilitate quantity manufacture. The vehicle is then driven to Aberdeen Proving Ground where it is operated over every conceivable type of road and cross-country terrain and is thoroughly tested to see if all parts meet the necessary requirements. Engineering data are obtained and recorded. The vehicle is then driven overland to the Armored Force Board at Fort Knox, Ky.—a trip that determines whether the vehicle is capable of long marches. The pilot vehicle of the scout car M3A1 made this trip of approximately 650 miles between 10 A.M. of one day and 4 P.M. of the next day, the driver and observers obtaining a full night's rest at the end of the first day's run. No trouble whatsoever was experienced and the only stops made were for meals and for purchasing gasoline.

Fig. 7. The Scout Car, M3

After arriving at Fort Knox, the car was thoroughly tested to determine its suitability for military use. After this test, the vehicle was driven to the manufacturer's plant and checked, and production was begun. The new scout car is now rolling off the assembly lines in large numbers and will become a major component of the new Armored Force of the U. S. Army.

Fig. 6. The Armored Car, M1, 1931

Editor's Note.—Another new vehicle, soon to take its place with the Armored Force, is the ¼-ton, 4-wheel-drive command-reconnaissance car, popularly known as the "bug," "bantam," or "blitz-buggy." This tiny vehicle is a combination passenger vehicle and truck and is designed to carry three men and a machine gun. It also can be used to carry light fieldpieces or for the quick transport of troops.

A total of 4,570 of these cars are now being delivered to the Army where they will replace the motorcycle to a great extent. Powered with a 4-cylinder engine, they have great cross-country mobility in addition to their generous carrying capacity. They are light enough to be lifted by hand should they become mired. On good roads they are capable of a speed of sixty miles an hour.

The adaptation of the 4-wheel drive to so small a vehicle is one of the outstanding features of the "blitz-buggy." The front-wheel drive can be disconnected when traveling over smooth terrain and used when the going gets rough. In addition to the regular transmission, the bantam has an auxiliary transmission which provides six speeds forward and two in reverse. Each car can carry a ¼-ton cargo and is equipped with deep-grip tires for added traction in climbing grades as steep as sixty-five per cent.

Other equipment includes a brush guard to protect the front lights and radiator and a detachable folding top which is carried in the tool compartment when not in use. The windshield folds flat over the hood and a pintle on the rear of the car makes possible its use as a prime mover. The cars also have front and rear blackout lamps for night driving under air-raid conditions. The low silhouette of the new vehicle makes it a difficult target, and its olive-drab lusterless finish makes the car easy to camouflage.

Armament Progress

Statistics of the Current Program

The following list of production contracts with private industry is published as further indication of the steady progress being made by the Ordnance Department of the Army in the production of military armament. Orders placed with Government arsenals and those below $25,000 are not included. These orders were placed during the period April 6, 1941 to May 31, 1941. For earlier orders under the military rearmament program, the reader is referred to the five preceding issues of this journal. A composite analysis of armament funds provided for the defense program since June 13, 1940, up to and including the Lease-Lend program, March 27, 1941, is given by classifications in the following table:

	Army	*Navy*	*Lease-Lend*
Airplanes, engines & accessories	*$ 3,594,000,000*	*$ 861,000,000*	*$2,054,000,000*
Guns, ammunition, etc.	*2,859,000,000*	*2,850,000,000*	*1,705,000,000*
Naval & merchant ships, transportation equipment	*447,000,000*	*6,736,000,000*	*629,000,000*
Posts, depots, and other non-industrial	*1,894,000,000*	*987,000,000*	.....
Other equipment	*1,043,000,000*	*225,000,000*	*510,000,000*
Industrial facilities	*1,509,000,000*	*882,000,000*	*752,000,000*
Other purposes	*1,789,000,000*	*1,094,000,000*	*1,350,000,000*
Total	*$13,135,000,000*	*$13,635,000,000*	*$7,000,000,000*

Artillery Matériel and Components

Facility	*Amount*
Aetna-Standard Engineering Co., Youngstown, Ohio	$ 30,000.00
Allegheny Ludlum Steel Corporation, West Leechburg, Pa	52,992.00
American Shim Steel Co., New Kensington, Pa	152,445.00
Falls Rubber Co., Findlay, Ohio	49,680.00
General Steel Castings Co., Eddystone, Pa	171,364.44
Great Lakes Steel Co., Boston, Mass	26,267.13
Hettrick Manufacturing Co., Toledo, Ohio	34,670.00
Hoe & Co., R., New York, N. Y	97,697.89
International Nickel Co., Huntington, W. Va	47,968.50
Kentucky Tent & Awning Co., Louisville, Ky	37,350.00
Lowell Wrench Co., Worcester, Mass	38,600.50
Martin-Parry Corporation, York, Pa	80,610.50
Midvale Co., Philadelphia, Pa	27,195.00
New Departure Division (General Motors Corporation), Bristol, Conn	32,989.18
Standard Steel Works Division (Baldwin Locomotive Works), Philadelphia, Pa	205,104.72
York Safe & Lock Co., York, Pa	44,441.25

Ordnance Production Contracts

Artillery Ammunition and Components

Facility	*Amount*
American Brass Co., Waterbury, Conn	$ 287,165.96
Bauer & Black Division (Kendall Co.), Chicago, Ill	43,720.18
Chase Brass & Copper Co., Waterbury, Conn	29,623.75
Chefford Master Manufacturing Co., Fairfield, Ill	181,120.00
Chevrolet Motor Division (General Motors Corporation), Detroit, Mich	531,774.00
Cleveland Container Co., Philadelphia, Pa	149,775.00
Copperweld Steel Co., Warren, Ohio	46,117.50
Crompton-Adelphia Corporation, John, Philadelphia, Pa	29,342.45
Doehler Die Casting Co., Pottstown, Pa	91,232.00
Doran & Sons, Inc., James C., Providence, R. I	30,537.50
Du Pont de Nemours & Co., E. I., Wilmington, Del	525,000.00
Electric Auto-Lite Co., Toledo, Ohio	860,000.00
Faries Manufacturing Co., Decatur, Ill	225,673.40
Faultless Caster Corporation, Evansville, Ind	331,500.00
Fulton Sylphon Co., Knoxville, Tenn	60,900.00
Goodwillie-Green Box Co., Rockford, Ill	782,618.25
Gould-Mersereau Co., Long Island City, N. Y	115,462.20
Grant Oil Tool Co., Los Angeles, Calif	70,115.75
Harding Machine Screw Co., East Liberty, Ohio	94,040.75
Jacobs Co., F. L., Detroit, Mich	436,840.00
Kilgore Manufacturing Co., Tipp City, Ohio	40,617.46
Kingston Products Corporation, Kokomo, Ind	627,000.00
Metal Products Co., Miami, Fla	516,000.00
Miller Manufacturing Co., Richmond, Va	356,000.00
Motor Wheel Corporation, Lansing, Mich	307,650.00
Mueller Brass Co., Port Huron, Mich	56,595.00
National Stamping Co., Lapeer, Mich	89,358.25
Ocean City Manufacturing Co., Philadelphia, Pa	26,460.00
Peco Manufacturing Corporation, Philadelphia, Pa	153,550.00
Revere Copper and Brass, Inc., Baltimore, Md	128,846.12
Robertshaw Thermostat Co., Youngwood, Pa	278,908.80
Standard Tube Co., Detroit, Mich	1,544,000.00
Stewart-Warner Corporation, Chicago, Ill	1,417,800.00
Superior Sheet Steel Division (Continental Steel Corporation), Canton, Ohio	60,620.80
Thompson Products, Inc., Detroit, Mich	146,000.00
Titan Metal Manufacturing Co., Bellefonte, Pa	126,000.00
Tredegar Co., Richmond, Va	319,099.04
Triumph Explosives, Inc., Elkton, Md	425,000.00
Tuthill Pump Co., Chicago, Ill	196,140.00
Union Drawn Steel Division (Republic Steel Corporation), Beaver Falls, Pa	30,720.00
Vernco Specialties Co., New York, N. Y	26,623.75
Volupte, Inc., Linden, N. J	281,976.20
Wadsworth Watch Case Co., Dayton, Ky	130,373.75
Winchester Repeating Arms Division (Western Cartridge Co.), New Haven, Conn	47,355.00

Small-Arms Matériel and Components

Bonney Forge & Tool Works, Allentown, Pa	$ 57,330.99
Colt's Patent Fire Arms Manufacturing Co., Hartford, Conn	205,950.18
Fischer Spring Co., Charles, Brooklyn, N. Y	50,396.50
Gilbert & Barker Manufacturing Co., West Springfield, Mass	39,734.27
Hummel & Downing Co., Milwaukee, Wis	34,105.00
Lite Manufacturing Co., New York, N. Y	81,334.55
Republic Steel Corporation, Cleveland, Ohio	109,140.00
Western Cartridge Co., East Alton, Ill	30,520.00
Wood Manufacturing Co., John, Muskegon, Mich	655,803.58
Yale & Towne Manufacturing Co., Stamford, Conn	100,611.00
Zimmerman Steel Co., Bettendorf, Iowa	36,835.10

Ordnance Production Contracts

Small-Arms Ammunition and Components

Facility	*Amount*
Brass Goods Manufacturing Co., Brooklyn, N. Y.	$ 135,965.00
Bridgeport Brass Co., Bridgeport, Conn.	1,574,275.00
Budd Wheel Co., Detroit, Mich.	55,000.00
Remington Arms Co., Bridgeport, Conn.	262,562.55
Western Cartridge Co., East Alton, Ill.	48,092.80

Bombs, Pyrotechnics, and Components

Budd Manufacturing Co., Edward G., Philadelphia, Pa.	$ 288,492.82
Buhl Stamping Co., Detroit, Mich.	232,000.00
Chattanooga Stamping & Enameling Co., Chattanooga, Tenn.	216,420.00
Glascock Brothers Manufacturing Co., Muncie, Ind.	246,000.00
Harrisburg Steel Corporation, Harrisburg, Pa.	1,471,180.00
National Tube Co., McKeesport, Pa.	2,450,000.00
Noblitt-Sparks Industries, Inc., Columbus, Ind.	244,000.00
Parsons Co., Detroit, Mich.	154,000.00
Ryerson & Haynes, Inc., Jackson, Mich.	253,750.00
Smith Corporation, A. O., Milwaukee, Wis.	3,224,000.00
Switlik Parachute & Equipment Co., Trenton, N. J.	157,300.00

Powder, Chemicals, and Explosives

Du Pont de Nemours & Co., E. I., Pompton Lakes, N. J.	$ 311,812.50
Hercules Powder Co., Kenvil, N. J.	436,400.00
Hercules Powder Co., Wilmington, Del.	588,087.50

Combat Vehicles, Automotive Equipment, and Accessories

Allis-Chalmers Manufacturing Co., Milwaukee, Wis.	$ 168,303.97
Cleveland Tractor Co., Cleveland, Ohio	49,640.18
Continental Motors Corporation, Detroit, Mich.	132,474.28
Continental Motors Corporation, Muskegon, Mich.	290,418.32
Eclipse Aviation Division (Bendix Aviation Corporation), Bendix, N. J.	97,792.14
Firestone Tire & Rubber Co., Akron, Ohio	151,481.00
General Tire & Rubber Co., Akron, Ohio	123,775.36
Guiberson Diesel Engine Co., Dallas, Tex.	33,079.85
Saginaw Stamping & Tool Co., Saginaw, Mich.	642,276.47
Sears Saddlery Co., Davenport, Iowa	83,295.60
Union Steel Castings Division (Blaw-Knox Co.), Pittsburgh, Pa.	31,000.00
Wallace Supplies Manufacturing Co., Chicago, Ill.	50,877.00
White Motor Co., Cleveland, Ohio	3,785,881.27
Wisconsin Axle Division (Timken-Detroit Axle Co.), Oshkosh, Wis.	107,000.00
Wood Manufacturing Co., John, Muskegon, Mich.	29,497.86
Wright Aëronautical Corporation, Paterson, N. J.	27,941.95
Zimmerman Steel Co., Bettendorf, Iowa	76,901.27

Fire Control

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.	$ 1,136,202.50
Perkin-Elmer Corporation, New York, N. Y.	34,646.50
Welsh Manufacturing Co., Providence, R. I.	35,460.00

Ordnance Production Contracts

Tools and Machinery

Facility	*Amount*
Accurate Tool & Die Co., Newark, N. J	$ 25,713.47
Ajax Electrothermic Corporation, Trenton, N. J	489,700.00
Austin-Hastings Co., Cambridge, Mass	33,220.00
Brown & Sharpe Manufacturing Co., Providence, R. I	68,382.78
Derbyshire Machine & Tool Co., Philadelphia, Pa	39,420.00
Ex-Cell-O Corporation, Detroit, Mich	48,485.80
Gar Wood Industries, Inc., Detroit, Mich	26,585.50
Gibbs Co., Thomas B., Delavan, Wis	64,796.00
Hawkridge Brothers Co., Boston, Mass	26,582.84
Heald Machine Co., Worcester, Mass	29,472.00
Homelite Corporation, Port Chester, N. Y	61,056.00
Karp Metal Products Co., Brooklyn, N. Y	31,796.50
Magnus Tool & Die Co., Newark, N. J	77,773.00
McKiernan-Terry Corporation, Dover, N. J	26,720.00
Modern Machine Tool & Die Co., Bridgeport, Conn	33,600.00
Morgan Machine Co., Rochester, N. Y	40,227.24
Niles Tool Works Division (General Machinery Corporation), Hamilton, Ohio	660,981.13
Pratt & Whitney Division (Niles-Bement-Pond Co.), West Hartford, Conn	28,995.00
Prescott Co., Menominee, Mich	682,500.00
Reliable Tool Co., Irvington, N. J	72,000.00
Roessler Machine Co., Elkins Park, Pa	37,991.00
Salem Engineering Co., Salem, Ohio	49,870.00
Seneca Falls Machine Co., Seneca Falls, N. Y	42,275.01
Shipley Machinery Co., W. E., Boston, Mass	118,236.80
Sipp-Eastwood Corporation, Paterson, N. J	29,160.00
Stedfast & Roulston, Inc., Boston, Mass	79,800.00
Texas Co., Chicago, Ill	31,007.50
Tungsten Electric Corporation, Union City, N. J	48,450.00
Universal Metal Products Co., New York, N. Y	89,160.00
Vandyck Churchill Co., New York, N. Y	121,863.00
Veit & Young, Philadelphia, Pa	214,435.00
Vulcan Mold & Iron Co., Latrobe, Pa	32,913.38
Waterbury Farrel Foundry and Machine Co., Waterbury, Conn	32,345.00
Watson-Stillman Co., Roselle, N. J	47,553.75
Westinghouse Electric & Manufacturing Co., Long Island City, N. Y	55,000.00
Wilson Brown Co., New York, N. Y	72,960.00

Gages

Fox Munitions Corporation, Philadelphia, Pa	$ 29,477.00
Pratt & Whitney Division (Niles-Bement-Pond Co.), West Hartford, Conn	48,317.50
Precision Manufacturing Co., Philadelphia, Pa	70,555.50
Quality Tool & Die Co., Indianapolis, Ind	73,474.95
Sheffield Gage Corporation, Dayton, Ohio	53,948.41

Facilities

American Metal Co., New York, N. Y	$ 39,230.00
Bausch & Lomb Optical Co., Rochester, N. Y	55,262.00
Germain Lumber Co., Pittsburgh, Pa	31,875.00
Ivory Pine Co., Klamath Falls, Oreg	65,825.00
Karp Metal Products Co., Brooklyn, N. Y	60,365.87
Kato Engineering Co., Mankato, Minn	27,998.23
Morton Manufacturing Co., Chicago, Ill	54,412.80
Sharp Lumber Co., J. F., Seattle, Wash	26,100.00
Sheldon & Co., E. H., Muskegon, Mich	174,899.20
Switzer Co., B. R., Charlestown, Mass	29,740.00

Planned Munitions, II

The Second Phase of the Current Armament Program

Lieut. Col. Henry S. Aurand*

THE first major appropriation act for munitions, known as the Second Supplemental National Defense Appropriation Act, Fiscal Year 1941, became law September 9, 1940, as described in the May-June issue of ARMY ORDNANCE (Vol. XXI, No. 126, p. 617). There were three documents prepared in connection with this act: (1) the Munitions Program of June 30, 1940; (2) the Expenditure Program pertaining to the Munitions Program of June 30, 1940; and (3) the Time Objectives for Requirements. These documents contained the results of munitions planning by the War Department to the date of passage of the appropriation act. In any appraisal of progress in the production of munitions, two underlying facts must be kept in mind: the first real money became available September 9, 1940, and the Munitions Program of June 30, 1940, was only two-thirds financed, leaving nearly two billion dollars to be carried as "deferred for future financing."

The Second Supplemental Appropriation Act was scarcely law before legislation authorizing the calling of the National Guard and selectees was passed. Instead of a protective force of 1,200,000 men which was envisaged in the preparation of the munitions program, an actual force of 1,418,000 was to be with the colors at the beginning of the fiscal year 1942. In order to provide individual equipment for this additional number and to make up some shortages, it was necessary to finance at once approximately $400,000,000 worth of items which had been deferred for future financing. A third supplemental appropriation act was passed late in September 1941. This act provided for the immediate requirements in equipment mentioned above and also supplied additional funds for expediting production. This appropriation became available about October 1, 1940.

Before describing the action following the availability of these funds, it is well to consider the atmosphere in which the War Department was working at the turn of the year. The expansion of the War Department caused by the increased load of both training and procurement was gradually taking place. The Secretary of War had appointed several civilian special assistants. The number of Deputy Chiefs of Staff had been increased. Every organization connected with munitions planning was expanded. In particular, the personnel of those concerned with actual procurement—the supply arms and services—was greatly augmented. The Advisory Committee to the Council of National Defense was slowly disappearing and was being replaced in the munitions field by the Office of Production Management. There were so many questions to decide that final decision on many matters had to be left to subordinates. There seemed to be neither enough personnel nor hours in the day.

Although the general organization of the War Department remained intact, the necessary decentralization resulted in three important separations. The first was that the field forces were separated from the administrative "Zone of the Interior" organization, and their training placed under General Headquarters at the Army War College. The second separation was not nearly so clear-cut in this period, although it might have been foreseen by careful reading of the objectives of the Munitions Program of June 30, 1940. These objectives defined, in so far as munitions were concerned, separate objectives for the ground army and the air army. The ground-army munitions objective continued to be defined as those supplies necessary to equip a force of a certain size and maintain it in combat for a certain period. For the air army, the munitions objective was being stated more and more frequently as so many complete military airplanes per month. The difficulty of going from one requirement basis to another led to a gradual separation not only of the determination of requirements for the ground and air armies, but also of the actual financing of these requirements.

THE third separation might also have been inferred by a careful reading of the objectives of the Munitions Program of June 30, 1940. There was a gradually increasing separation between the requirements and financing of articles which were to be procured and the facilities or capital investment provided by the Government for the production of these articles. As stated in the objectives of the munitions program, procurement of items of equipment was limited to the essential equipment required by a force of 1,200,000 and the critical supplies needed to equip and maintain a ground force of approximately 2,000,000 men on combat status; whereas facilities for production provided not only for this objective but also for the creation of "additional facilities requiring a long period of time to place in operation and needed for the expansion of the Army." During this period, the objective for facilities was restated as: the facilities necessary to provide the productive capacity for equipment to meet combat requirements for a force of approximately 4,000,000 men.

The contracting phase after the passage of the Second and Third Supplemental Acts had scarcely begun before the War Department, then faced with the training of the National Guard and selectees, began the necessary overhauling of its tactical organizations and their equipment, in order to apply the lessons learned on the battlefields of Europe. With an apparent sufficiency of money for munitions for the time being, the War Department took three months to revise the three basic documents of munitions requirements: Tables of Organization, Tables of Allowances, and the Troop Basis.

Toward the end of December 1940, revision had reached the point where new computations of supply requirements could be made by the supply arms and services. In order to stabilize the requirements for munitions through the budgetary period, a rather complete freezing of these underlying bases of computation was directed immediately after this revision.

The directive for the computation of these revised requirements instructed each supply arm or service to deter-

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This article brings up to date the historical record of our current preparedness planning. The first phase was discussed in the May-June issue.

mine, in addition to its requirements, its position with reference to its stocks and orders. The results were compiled in a document called "Status of Equipment as of January 1, 1941."

HOWEVER, due to the necessity of printing the President's budget and placing this document in the hands of Congress at its opening session in January 1941, the fiscal year 1942 estimates for equipment could not await the recomputation of requirements described above. It was, therefore, necessary to prepare estimates based upon completing the Munitions Program of June 30, 1940. As a result of the recomputation of munitions requirements based upon the needs of a modern army and subsequently issued to the services on January 30, 1940, under the title "Status of Equipment as of January 1, 1941," it was apparent, as had been anticipated, that changes in organization, the standardization of new equipment, and new allowances had resulted in a greatly increased amount of equipment per man and tactical unit. This, of course, produced a much larger requirements figure for munitions, with a corresponding greater dollar value.

It was also clear that as the war in Europe progressed it would be necessary from time to time to change the basic equipment requirements. In order that industry might not be subjected to continual changes in orders, it is desirable to obtain this flexibility in requirements by fixing each step of procurement and by making changes as further financing is necessary. For example, if the initial financing of the Munitions Program of June 30, 1940, is considered as the first step, no major changes will be made in the orders placed from these funds.

The completion of the financing of the Munitions Program of June 30, 1940, then can be considered as the second step, and no major changes will be made in the articles to be procured from these funds. There will have to be a third step to make good the shortages which will still exist based on the "Status of Equipment as of January 1, 1941." This again can be left unchanged when the funds become available. Any further changes in requirements will have to be accomplished by further financing.

THE status of equipment as of January 1, 1941, became available to the supply arms and services of the War Department about February 1st. Faced with this third step in requirements and financing, and with a demand from both OPM and industry for the placing of additional orders, the War Department determined that it could not well await the financing of the deferred portion of the Munitions Program of June 30th until the date of availability of fiscal year 1942 appropriations (July 1, 1941). The Fourth Supplemental Appropriation Act containing funds for military construction was necessary at this time. The necessity for a similar supplemental appropriation for equipment was, consequently, rather easily demonstrated. The result was the submission to Congress of the estimates which later became the Fifth Supplemental Appropriation Act. This bill was signed by the President early in April 1941.

It might be noted that the Fifth Supplemental Act contained provision for the second sizable grants obtained for the procurement of munitions. It contained funds for procurement of the deferred items of the Munitions Program of June 30, 1940. Also provided for was an increase in procurement of aircraft resulting directly from a consideration of the types and increased numbers required as indicated by European experience. In so far as munitions planning is concerned, *finis* may be written to the Munitions Program of June 30, 1940. It is up to industry to produce the articles which it authorizes. The quantities of equipment needed to complete the requirements shown in the "Status of Equipment as of January 1, 1941" remain to be financed.

THE unforeseen usually arises to disrupt the best-laid plans. In May and June 1940, it was impossible to predict the Lend-Lease Bill of March 11, 1941. The great difficulty concerning production for foreign nations at that time was the fact that they were placing contracts with the industries from which the War Department had counted on obtaining early production. As the year 1940 wore on, it became evident that contracts were being placed by foreign nations in continually lesser amounts. By November, contracts of this nature were no longer being placed. Instead, a demand was being made on this Government for the release of its surplus munitions. In January 1941, the President asked the Congress for the authority contained in the Lend-Lease Act. It may be well to say here parenthetically that "Lend-Lease" is now known as "Defense Aid" and will be so referred to hereafter.

Immediately after the President's request to Congress, the munitions planners of the War Department made an effort to evaluate Defense Aid in terms of munitions. The immediate necessity was some basis on which to establish requirements. Since the basic bill had not yet passed Congress, conversations with foreign governments, which would be benefited by the provisions of the act, were accompanied by great secrecy and some indirection. The British had by far the greatest stake in existing contracts in the United States; it also was obvious that the British would have the greatest requirement for aid after the bill was passed. It was natural, therefore, to endeavor to determine from the British the basis for Defense Aid requirements. Conversations with the British were largely restricted to those between individuals until late in January 1941. At this time the over-all British needs from United States production became available to the War Department. Obviously, these lists contained information of great value to the enemies of Britain and consequently could not be made public.

During late January and early February, conversations were held between various Government departments and the Bureau of the Budget as to the method of financing Defense Aid. Certain preliminary actions were taken as to standardization of types of equipment. On Washington's Birthday it became possible for the War Department representatives to sit with the British and list the specific requirements. Later on, meetings were held to determine the procedure which would be placed in effect to implement any defense-aid appropriation act which might follow the passage of the original bill.

While the original bill was still in discussion before the Senate, the War Department was advised of the extent of its part of the appropriation which would be requested from Congress. It was then necessary to meet again with the British representatives and accommodate their requirements to these funds in order that proper defense of estimates could be made. Because of this preliminary planning, the War Department was able to support its share of Defense Aid funds with specific lists of equipment and was prepared to proceed with the expenditure of the funds as soon as they became available.

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JULY-AUGUST, 1941

Month by Month

WILLIAM S. KNUDSEN, DIRECTOR GENERAL OF the Office of Production Management, gave this reassuring message recently:

"With the first year of the defense program coming to a close, the results obtained can be credited to the coöperation of the parties involved; *viz.*, the services (the Army and the Navy), Congress, industry, and labor. New industrial facilities—1,625 projects—have been started, the amount involved being $2,840,000,000—Government, private, and British financed. Contracts in the amount of $15,200,000,000 have been placed with industry and in Government arsenals. Every effort has been made to spread the load over the United States, and practically every state in the Union has shared in facilities, contracts, or subcontracts.

"Airplane and engine factories have been planned for the quantity our President outlined in the original directive. The Navy program has been placed in navy and private yards. Mercantile shipbuilding has been expanded to handle both standard and special ocean-going vessels. Tanks, guns and ordnance, powder and explosives have all been provided with facilities to insure manufacturing in quantities. We have made a start, and production should increase with every month from now on. We are not by any means satisfied with the progress made to date. We need the help of every manufacturer, engineer, and production worker to get this industrial machine speeded up to its highest efficiency. We ask the support of this defense program from every citizen of the United States."

Elaborating upon Mr. Knudsen's statement, John D. Biggers, Director of Production under Mr. Knudsen, said:

"We may look back on the first year of our intensified defense program with mixed feelings. On the one hand, the people of the United States have good reason to be pleased with the important strides taken toward preparing this country for the production of defense equipment on a huge scale. On the other hand, they dare not be satisfied, because the task has grown so great since the program was first undertaken that any fair analysis leads to the conclusion that far greater effort must be made during the second year."

Coördinate with these conditions in respect of arms, the numbers of men for whom they are needed in the Army continue to grow apace. The strength of the Army, June 5, 1941, was estimated at 1,362,300 officers and enlisted men. Officers: Regular Army, 14,000; National Guard, 21,800; Reserve officers, 49,500; total, 85,300. Enlisted men: Regular Army, 3-year enlistments, 470,000; Regular Army Reserve and 1-year enlistments, 18,000; National Guard in Federal service, 269,000; Selective Service trainees, 520,000; total, 1,277,000.

THIS IS THE PICTURE OF DEFENSE PRODUCTION at the end of May 1941: *Machine tools:* The annual volume of machine-tool manufacturing has risen from $220,000,000 in 1939 to $450,000,000 in 1940 to an estimated $750,000,000 in 1941. May production this year is expected to be more than double that of May 1940. Trade estimates are that 1,000 machine tools are being delivered daily to defense industries.

Aircraft: Actual production of 1,376 military airplanes in April was more than 3 times what it was in June 1940. Manufacturers' estimates for May would represent quadrupled production within the year. Monthly output in March 1940 was only 287. The output of all types of military planes was almost 9,000 for 11 months. When May's production is added, the year's record was expected to fall just short of 10,500.

Estimated May production of bombers and pursuit planes is more than two and a half times the July 1940 figure. Scheduled deliveries of trainers will be even greater, and the expected output of observation, transport, and other tactical planes, while numerically smaller, were more than four times July deliveries.

The monthly production of major airplanes, exclusive of civilian light aircraft, from July 1940 through April 1941 follows (figures shown in italics are military and naval types included in the total): *1940:* July, 547; August, 586; September, 670; October, 742; November, 779; December, 900; *1941:* January, 1,036, *(957);* February, 972, *(879);* March, 1,216, *(1,074);* April, 1,427, *(1,376).*

Ships: Major combatant ships under contract or on order April 30th numbered 360, of which preliminary work actually had started on 312. The Navy contracted for 629 vessels, large and small, during the current fiscal year, as against 23 in the preceding year. On January 1, 1940, there were only 43 major combatant ships on order or under contract. Ship construction is the slowest of all defense production, but many vessels are being built ahead of schedule. Total tonnage of major combat vessels on order last July 1st was 585,930 tons; by April 30, 1941 it was 2,226,950. Auxiliary vessels under construction between the same months had risen from 74,938 to 282,507 tons.

The following tables present the picture of progress briefly. Ships shown on hand are as of less than a year ago

because of the transfer of fifty destroyers to Britain in exchange for naval air bases. The number of combatant ships also was reduced by the reclassification of thirty destroyers as "special-purpose" vessels.

Combatant Ships	*On hand Jan. 1, 1940*	*On hand May 1, 1941*	*On order May 1, 1941*
Battleships	15	15	17*
Aircraft Carriers	5	6	12
Cruisers	34	37	54
Destroyers	218	165	199
Submarines	87	109	78
Totals	359	332	360

*Includes U.S.S. NORTH CAROLINA and U.S.S. WASHINGTON, 35,000-ton dreadnaughts, which have been launched but have not yet joined the fleet.

Tanks: Light—13-ton—tanks are being produced at the rate of about 150 a month. Medium—26-ton—tanks were redesigned in accordance with experience of the British and French armies in Flanders. Production was delayed purposely so that machine-tool priority could be given more critical military weapons. Quantity production of medium tanks is expected by late summer.

The Army has more than four times as many light tanks on hand as it had last July. By July 1941, the increase was expected to be six-fold.

Ordnance: Machine guns, rifles, munitions, and ammunition are being turned out in quantities that represent large increases over production a year ago. Powder output has risen 1,000 per cent, small-arms ammunition 1,200 per cent. Twice as many Garand rifles are coming out monthly as in July 1940. The output of caliber .30 machine guns has trebled, that of caliber .50 machine guns has quadrupled. Gains of 40 and 35 per cent, respectively, have been made in the manufacture of field artillery and antiaircraft artillery. Scout cars, which are well-armed combat vehicles, are coming out at the rate of 400 a month. By July the Army will have its present requirements.

ARMY ORDNANCE ARSENAL DAY, JUNE 10, 1941, served a double function: it honored the 40,000 workers in the various arsenals, and it introduced to a nation-wide audience Irving Berlin's new Army Ordnance song, "Arms for the Love of America." Maj. Gen. C. M. Wesson, "Chief of Ordnance, United States Army, designated June 10th as Arsenal Day to commemorate the traditional rôle of the Ordnance arsenals as the corner stone of armament production since post-Revolutionary War days. The program was broadcast by the National and Columbia Broadcasting Systems over coast-to-coast networks from 9:30 to 10 P.M. in the evening.

The focal point of the ceremonies was the Army Band Auditorium of the War College at Washington, D. C. Under Secretary of War, Robert P. Patterson, and General Wesson there received radio reports from the commanding generals of the six Ordnance Department manufacturing arsenals. Arsenal commanders who broadcast from their own headquarters were: Brig. Gen. G. H. Stewart, Springfield Armory, Springfield, Mass.; Brig. Gen. W. P. Boatwright, Frankford Arsenal, Philadelphia, Pa.; Brig. Gen. E. M. Shinkle, Picatinny Arsenal, Dover, N. J.; Brig. Gen. R. W. Case, Watertown Arsenal, Watertown, Mass.; Brig. Gen. A. G. Gillespie, Watervliet Arsenal, Watervliet, N. Y.; and Brig. Gen. N. F. Ramsey, Rock Island Arsenal, Ill.

Preceding the arsenal reports, which reviewed briefly the work of each arsenal and how arsenal employee-military cooperation has strengthened the defense effort after each war in which the United States has been engaged, there were brief addresses by Secretary Patterson and General Wesson.

Mr. Berlin, writer of many of the songs sung by United States troops in the World War, then presented to General Wesson his latest work, "Arms for the Love of America," which was sung for the first time. The soloist was Barry Wood accompanied by the Lynn Murray Singers and the Army Band.

Mr. Berlin composed "Arms for the Love of America" for General Wesson at the request of Lieut. Col. John B. Bellinger, executive assistant to the Chief of Ordnance. Colonel Bellinger suggested that the song symbolize the need for production and at the same time serve an inspirational purpose in defense industries. All profits from the sale of copies by the publishers will be donated to Army charitable and relief purposes.

"Arms for the Love of America" is a rollicking, snappy march which bids fair not only to inspire determination by all for the defense effort but also to remain as the accepted Ordnance song—in the Army and out—for generations to come. The words:

I

On land and on the sea and in the air,
We've got to be there,
We've got to be there!
America is sounding her alarms:
We've got to have arms,
We've got to have arms!

(Chorus)

Arms for the love of America!
They speak in a foreign land
With weapons in every hand,
Whatever they try we've got to reply in language
that they understand:
Arms for the love of America!
And for the love of ev'ry mother's son
Who's depending on the work that must be done
By the man behind the man behind the gun.

II

They're in the camps and in the training schools,
Now give them the tools—
They've got to have tools!
We called them from the factories and farms,
Now give them the arms—
They've got to have arms!

(Chorus)

Arms for the love of America!
We've got to get in the race
And work at a lively pace.
They say over here we've nothing to fear but let's
get ready—just in case.
Arms for the love of America!
And for the love of ev'ry mother's son.
Oh, the fight for freedom can be lost or won
By the man behind the man behind the gun!

Our military arsenals, repositories of the skill of armament manufacture, are a priceless national heritage and an ever-present help to our national defense in providing teachers to train industry in the armorer's art.

Defense Strikes

An Editorial

THERE is entirely too much malodorous humbuggery on the subject of defense strikes. Either we are going to produce military armament to meet the declared unlimited national emergency or we are not. If we are going to produce, then we must produce—and nothing anywhere can be permitted any longer to interfere. For defense strikes have already done irreparable harm to the armament program and bid fair to scuttle it unless the racketeers are smoked out at once. The plain truth is that defense strikes and armament production do not go together. If good American testimony is not admissible as to this, ask any Frenchman!

What are the facts? In the first 120 days of the year 1941, there were 127 defense strikes (on military projects only) for a loss of 1,464,207 man-days of work. In one week alone (February 24th to March 1st) it was estimated that the defense-strike toll was 120,000 man-days of production in plants working on supplies for the Army. By May 27th, it was estimated that the figure had grown to 2,023,216 man-days of work (exclusive of Saturdays, Sundays, and holidays) lost through strikes in plants handling War Department orders. Statisticians estimated that this loss could be translated into 44,500 Garand rifles or 285 light tanks.

The following are losses in man-days by months for the year: January, 101,540; February, 429,779; March, 664,519; April, 372,478; May, 454,900. Result: Accumulating delays in production, to say nothing of mounting money costs, postpone the time when our major shortages of guns, ammunition, ships, airplanes, and all the related equipment can be met.

What are the attitudes in the face of this disgraceful record? On the part of Labor, the attitude of the vast majority of workmen, as you talk with them at their machines and with many of the leaders, is one of loyalty. They seem anxious to get the job done and to iron out their differences with management on a fair, honest basis. On the part of Management, the attitude of the vast majority of officials—except the comparatively few enemies within our gates who thrive on sweatshops, price cutting and not-one-penny-more-than-the-wage-laws-provide—is one of utmost coöperation and willingness to deal on a fair and honest basis.

ON the part of Government, the attitude is more difficult to define. Words, words, words, issue from the mimeographs, but seldom a foursquare look at the issue. At this writing, few officials have had the courage to demand legislation for a "cooling-off period" before defense production can be stopped—similar to the limitation on railroad employees. And the result? A little band of willful men is permitted to interfere with the arms-production program of the United States of America despite the emergency needs of the armed forces. And this in a day when the young manhood of our country is being called to the colors under a Universal Service Act!

When the people will decide to face this vital issue is problematical. It is not the function of this journal to influence them or their elected representatives. But certain basic results are so clearly indicated if defense strikes do not end promptly and completely—not occasionally or partly, and not with double time for every little extra effort for defense—that these results should be stated fearlessly for all to read:

First, there is the simple mechanical axiom that as you dissipate energy less work is done. Applied to armament production, that means that idle hands and idle machines do not produce guns and ammunition. Armament differs not at all from any other thing—you cannot have your cake and eat it. Soldiers without weapons in battle must pay the price in blood!

Secondly, the Army and Navy of the United States can do just so much in this job of national defense—the rest depends on the men and women behind the men behind the guns. The fighting services have no right or title to interfere with labor. They have no desire to. Their whole tradition is opposed to interference in the slightest degree with civil functions of government. The Army of the United States does not make war, foreign or domestic. On this score, in a famous statement to the chairman of the House Military Affairs Committee twenty-one years ago, Secretary of War Newton D. Baker said:

"I know of no war in which America has been engaged, offensive or defensive, which was brought about by Army pressure or, indeed, stimulated by military desire, nor has there been within my lifetime or within the history of the country, so far as my knowledge of it goes, a time when the Army or Army opinion was in the slightest degree menacing to the liberties of the American people or insubordinate to civil control."

That holds good today, of course. But by the same token, it is a dastardly denial of fair play if any element of our people in the present production emergency sells the Army short.

THIRDLY, and most important—not one ten-millionth of our people have any conception whatever of the meaning of military defeat in time of war. They read casually of conquering armored columns sweeping across public gardens and taking position at strategic points as though this thing were a kind of dress parade or maneuver. They seem to think that when official courtesies by the invaders are completed, calls returned, and taxis operating again, the defeated peoples go on about their affairs with business as usual. *Pipe dreams!* War as it is waged in this "enlightened" generation is absolute—the victor's will is imposed *completely*. What he demands is substance, wealth in every form—metals, minerals, machines, men, the assets behind bank deposits and insurance policies.

Military defeat these days means all that—and more. It means a lost national morale—sometimes the loss of the will to recover. And that state is worse than the first, for when national discipline is gone, the game isn't worth the candle. Military defeat in this twentieth century is stark, abject, thorough, absolute! If there be the slightest doubt of this, look to the defeated countries of Europe in this summer of 1941.

Defense strikes! They are not only the negation of Americanism—they defy common sense. He who fosters them imposes a burden which loyal shoulders should not be made to carry. For he weakens the national strength at a time when national strength—and that alone—can guarantee us against the tragic possibilities of military defeat. L.A.C.

Association Affairs

LOCAL Posts of the Army Ordnance Association were especially active during the months of April and May. Annual meetings were held by the Cincinnati, St. Louis, Philadelphia, Rochester, and Pittsburgh chapters; the Washington Post continued its monthly luncheon meetings. These gatherings were marked by unusually large attendance. Officers of the Ordnance Department, United States Army, particularly the Chief of Ordnance, Maj. Gen. C. M. Wesson, and Brig. Gen. C. T. Harris, Jr., chief of the Industrial Service, were most gracious in addressing the meetings. Officials of the Office of Production Management, including John D. Biggers, chief of the Production Division, E. F. Johnson, in charge of ordnance, aircraft, and tools, and A. R. Glancy, in charge of the Ordnance Section, also spoke to the assembled members. All in all, the period was one of unusual activity and brought to the members a better understanding of the problems and achievements of the Ordnance production program.

Cincinnati Post

FIRST of the annual meetings during the 2-month period was that held under the auspices of the Cincinnati Post at Queen City Club, Cincinnati, on the evening of April 12th. The principal speakers were General Wesson, who spoke on "Machinery for Defense"; and Mr. Biggers, whose topic was "The Battle of Production." (Mr. Biggers' address is published in full on page 25 of this issue.) Lieut. Col. Fred A. McMahon, secretary of the Cincinnati Post, and Lieut. Col. L. A. Codd, editor of Army Ordnance, also addressed the meeting.

August H. Tuechter, president of the Post, presided as toastmaster and introduced General Wesson and Colonel McMahon. Mr. Biggers was introduced by E. A. Muller, chief of the Cincinnati Ordnance District; Colonel Codd was presented by Frederick V. Geier, the assistant district chief.

General Wesson directed his remarks to the reliance of the defense program upon machines as well as men. He said in part:

"The Industrial Mobilization Plan developed by the Army and Navy during the past decade attempted to provide for an equitable nation-wide distribution of a prospective emergency load to industry. We have made full use of our plans. As proof of this, I can tell you that ninety-five per cent by amount and ninety-one per cent by number of ordnance awards have been placed with companies allocated to the Ordnance Department under the Industrial Mobilization Plan. . . .

"The Ordnance organization has several characteristics which I think are fundamentally sound. It connotes decentralized operation. It is based on an experience of twenty years of close cooperation with American industry. It contains the necessary safeguards to protect the interests of the American taxpayer while also demanding that the taxpayers' interests in the national defense be kept paramount.

"Here in Cincinnati, the machine-tool capital of the world, permit me to congratulate you gentlemen on the marvelous results your industry has brought about during the past year. I am told this industry will treble its production this year. This is a magnificent record. I am told that much of this achievement will be brought about through the prompt and effective subcontracting of certain of your requirements. This principle should be given wider application throughout the entire defense program. Your greatly increased production has tremendous implications for our ordnance program, which demands a large percentage of your combined output.

"In the Ordnance Department we did all we could to anticipate emergency requirements of machine tools. Two years ago, Congress approved our recommendation for a $16,000,000 program to replace obsolete machinery in the arsenals. The machines on this program are now turning out armament. But it was in the field of powder-making machinery, especially, in which we anticipated requirements. As a consequence, we have saved many vital months in equipping certain of our new powder plants, because this machinery is very special and requires considerable time to produce. I only wish that it had been possible for us to have had much more of it on hand ready for installation.

"All this took money and, strange as it may seem now, money was then scarce. In the absence of money we had designs prepared of single-purpose machines that could be made by other than the regular machine-tool builders. Through industrial planning, the requirements of additional machines were known. This saved time in the placement of orders by our manufacturers; and while Old Man Priority has knocked us back a pace, we are not going to let him whip us!"

Seated at the speakers' table, in addition to those already mentioned, were: Jack C. Carlton, Carlton Machine Tool Co.; C. W. Wheland, director, Cincinnati Post; Maj. A. F. Hubbard, Kilgore Manufacturing Co.; C. L. Bauer, Bauer Brothers Co.; F. H. Irelan, Delco Products Division, General Motors Corporation; Louis Schwitzer, director, Cincinnati Post; F. L. Burke, Guide Lamp Division, General Motors Corporation, director, Cincinnati Post; Charles F. Williams, Western & Southern Life Insurance Co.; E. R. Godfrey, Frigidaire Division, General Motors Corporation; S. C. Allyn, National Cash Register Co.; A. J. Moses, Combustion Engineering Co.; James S. Watson, Link Belt Co.; Carl J. Winkler, U. S. Machine Corporation; R. R. Deupree, chief, Division of Agriculture and Forest Products, Office of Production Management; Harvey C. Knowles, assistant chief, Cincinnati Ordnance District; G. A. Rentschler, General Machinery Corporation; B. B. Quillen, Cincinnati Planer Co.; George C. Brainard, coördinator, Fourth Federal Reserve District, Cleveland, Ohio; Herman Lind, district manager, Defense Contract Service, Federal Reserve Bank of Cleveland; Clifford Wright, district manager, Defense Contract Service, Cincinnati Branch, Federal Reserve Bank of Cleveland; William L. Dolle, Lodge & Shipley Machine Tool Co.; Col. C. O. Sherrill, City Manager, Cincinnati, Ohio; L. W. Scott Alter, American Tool Works Co.; R. E. LeBlond, R. K. LeBlond Machine Tool Co.; Col. A. H. Pugh, vice-president, Cincinnati Post; Col. George G. King, King Powder Co.; Louis Poock, Sheffield Corporation; Lieut. John D. Wyatt, treasurer, Cincinnati Post.

Nearly 500 members and guests were in attendance. Colonel McMahon and his committee were praised for the excellence of the meeting in all its details.

St. Louis Post

THE annual meeting of the St. Louis Post was held at the Hotel Chase, St. Louis, on the evening of Monday, April 21st. General Wesson, Harry B. Wallace, district coördinator of the Defense Contract Service, OPM, Col. Harry Scullin, chief of the St. Louis Ordnance District, Msgr. John P. Spencer and Colonel Codd addressed the meeting. Lieut. Col. Edwin B. Meissner, president of the Post, presided.

Seated with the guests of honor at the speakers' table were: Col. Carl H. Müller, headquarters, Third Military Area; Willard R. Cox, assistant chief, St. Louis Ordnance District; R. L. Lund, Lambert Pharmacal Co.; Walter W. Smith, president, First National Bank; Arthur G. Drefs, McQuay-Norris Manufacturing Co.; James Anderson, Humble Oil & Refining Co.; Maj. Randall J. Hogan, executive officer, St. Louis Ordnance District; W. H. Bixby, G. H. Walker Co.; H. O. Clarke, Houston Lighting & Power Co.; J. M. Kurn, trustee, St. Louis-San Francisco Railway Co.; Thomas N. Dysart, president, St. Louis Chamber of Commerce; Emmett V. Thompson, Thompson, Kincade, O'Conner & Powers; A. C. Stannard, Southwestern Bell Tele-

phone Co.; H. B. Deal, assistant chief, St. Louis Ordnance District; Emmet T. Carter, Carter & Small; W. T. Nardin, chairman of board, Federal Reserve Bank; E. W. Davis, Westinghouse Air Brake Co.; Col. Ford Richardson, Army recruiting officer.

General Wesson said in part:

"I have chosen 'Armament—as Planned' for my topic. Every step of the way thus far in the production of our military armament has been planned carefully and thoughtfully over many many years. There should be much consolation for every citizen of the United States in the knowledge that what we are doing for our armament is being done because 'we planned it that way'!

"To describe adequately what is being done today one must know what has been done. Indeed, one must know accurately our experiences during the World War. It is only by such a comparison that the worth of our present undertaking becomes apparent. The measure of our progress today can be understood best by comparing it with the measure of our progress in our last great national armament effort. To describe our World War experience does not require any lengthy dissertation. In a word, we had no adequate plans, no adequate organization, no adequate understanding of the military armament problem in all its ramifications. . . .

"Our country must plead guilty to the charge of gross forgetfulness of many of its military experiences. But this lesson of industrial preparedness was one lesson which we did not forget. After the World War, patriotic men came forward to see to it that that lesson would not be forgotten. The result was a series of historic moves in quick succession. The National Defense Act of 1920 became the organic law of the land. Plans were immediately started for decentralized procurement under the Ordnance system, and the fourteen Ordnance districts were established on a skeletonized basis. They have been in operation continuously now for twenty years. An Industrial Mobilization Plan, representing the best thought of industry and the engineering, military, and naval professions, was adopted and revised from time to time. All in all, the job of armament in time of emergency was kept currently alive to every changing condition of our economic and military life. The final result was that we have had a *living* plan activating a *living* organization.

"When emergency came to us last year, we were not caught napping. The Ordnance Department and those portions of American industry which had been associated with it in its plans knew a great deal about their jobs. Our armament effort was—and is—a planned effort. What has been done and what is now being done is according to plan. That must never be forgotten! He who is not cognizant of it or he who misrepresents our effort as being haphazard simply does not know whereof he speaks."

Major Hogan was in charge of arrangements. His committee continued an Ordnance tradition in St. Louis by arranging a meeting that surpassed any in the Post's history.

PHILADELPHIA POST

NEARLY 1,200 members and guests attended the annual meeting of the Philadelphia Post at the Bellevue-Stratford Hotel on the evening of May 6, 1941. The program consisted of the following: invocation by the Rev. Nathaniel B. Groton, rector, St. Thomas' Church, Whitemarsh, Pa.; introduction by the toastmaster, C. Jared Ingersoll, president, Philadelphia Post, and district chief, Philadelphia Ordnance District; greetings from the Navy by Rear Adm. Adolphus E. Watson, U. S. N., commandant, Fourth Naval District and commandant, Philadelphia Navy Yard; addresses by Brig. Gen. C. T. Harris, Jr., Assistant to the Chief of Ordnance, and chief of Industrial Service; John D. Biggers, director, Production Division, Office of Production Management, and Lieut. Col. L. A. Codd, Ord. Res., executive vice-president, Army Ordnance Association.

General Harris described the status of Ordnance production especially as applied to the Philadelphia Ordnance District and urged the united coöperation of all engineers and manufacturers in the current mammoth effort. He complimented Mr. Ingersoll, the district chief; Lieut. Col. D. N. Hauseman, executive officer of the district; and Maj. W. S. Broberg, assistant executive officer. These officers were in direct charge of the dinner and meeting and arranged a most interesting series of exhibits adjacent to the banquet hall. Murals formed the background for the exhibits depicting defense on sea, land, and air. These were sponsored by Baldwin Locomotive Works, J. G. Brill Co., and Edward G. Budd Manufacturing Co. The Bartlett Hayward Division of Koppers Co. provided two 37-mm. antiaircraft gun mounts for public display in front of the hotel.

Mr. Biggers spoke in part as follows: "There is one factor in this picture that is tremendously reassuring, and to omit mentioning it would be to commit a great injustice. I want to express a genuine admiration for what the military services have done, for it is they who are primarily responsible for the progress made to date on this program. Through the long, lean years when this country was seeking the ways of peace by setting an example of disarmament for the rest of the world, the officers of the Army and Navy were quietly, patiently planning against the emergency in which we are today involved. They might easily have become discouraged during the years of meager appropriations. There is no use being bitter about that now and it is to the credit of our professional officers that they did not become bitter. They made the best of a bad situation and went ahead surveying, blueprinting, planning how and where they could rebuild the great munitions industries we had destroyed after the last war. We may thank our stars that they did, for without the groundwork and preparations they made it would have been impossible to be as well along as we are today.

"I also want to pay a tribute to the extraordinarily high character and caliber of the men in the armed services, not just to be polite, but to recognize true merit, for, after all, this is primarily their program and they are doing a great part of the work. We in the Office of Production Management are there only to assist them, to help out whenever and wherever we can. You in Philadelphia know the general ability and coöperative spirit of the local Ordnance officers. No Ordnance district in the country is administered better than is the Philadelphia District. It is typical of the merit that runs through the Ordnance branch and it is a godsend in this crisis.

"Here we are, then, faced with a job of colossal magnitude, fortunately in the hands of competent directors. We manufacturers must assume our share—and it is a tremendous share—of the responsibility to our country and to ourselves, for if our country fails, so do we; if democracy goes down the drainpipe of history so does the free economic system within which free enterprise must work. Percentage-wise, your job—the job of manufacturing ordnance to meet our ever-expanding requirements—is the greatest of any group. Over the past twenty years or so, the Ordnance Department has been accustomed to an annual appropriation of a little over $28,000,000. Today we are faced with the production of roughly $4,000,000,000 worth of ordnance equipment. From $28,000,000 to $4,000,000,000 is an increase of 14,000 per cent. Think about that for a minute. Have you ever heard of any other business increasing by 14,000 per cent in so short a time? Do you wonder that I say that this is a colossal undertaking, or that you have the most difficult job of all?"

ROCHESTER POST

AT the Oak Hill Country Club, Rochester, N. Y., on the evening of May 7th, the annual dinner and meeting of the Rochester Post, Army Ordnance Association, was held. Again, attendance surpassed all previous records. The invocation was given by Rev. George F. Kettell. Hon. Samuel B. Dicker, Mayor of Rochester, delivered an address of welcome. General Wesson and A. R. Glancy, chief of the Ordnance Section, Office of Production

Management, gave the principal addresses. General Wesson was introduced by Irwin R. Davenport; Mr. Glancy by Edward A. Halbleib.

The addresses were broadcast over a coast-to-coast network of the Mutual Broadcasting System. Following the meeting, a sound Kodachrome motion picture, "Machining 75-mm. Shell M48," was shown. The picture was produced through the joint efforts of the Rochester Ordnance District, the General Railway Signal Co. and the Teaching Films Division of the Eastman Kodak Co.

The presiding officer at the meeting was Frank J. Smith, president of the Rochester Post. He and Lieut. Col. Roy L. Bowlin, secretary of the Post, arranged one of the most attractive and interesting programs ever presented by any local chapter of the society. Among those at the speakers' table, in addition to the guests of honor, were the members of the Rochester Ordnance District Advisory Board including: Carl S. Hallauer, Bausch & Lomb Optical Co.; Raymond N. Ball, Lincoln-Alliance Bank & Trust Co.; Herbert W. Bramley, Sibley, Lindsay & Curr Co.; John F. Cunningham, General Electric Co.; Mark A. Daly, Associated Industries of New York State; Robert E. Dillon, Lake Erie Engineering Co.; M. Herbert Eisenhart, Bausch & Lomb Optical Co.; Bernard E. Finucane, Security Trust Co.; James E. Gleason, Gleason Works; Myron J. Hayes, Eastman Kodak Co.; Fred F. Hickey, Savage Arms Co.; Arthur J. Ingle, Consolidated Machine Tool Co.; John W. Jardine, Genesee Valley Trust Co.; Col. William Kelly, Niagara & Hudson Power Corporation; Thomas L. Lee, Rochester Products Division, General Motors Corporation; Ivar Lundgaard, Rochester Gas & Electric Corporation; Edward G. Miner, Pfaudler Co.; Henry D. O'Connell, Central Trades & Labor Council; Col. Thomas H. Remington, attorney at law; Frank J. Smith, John P. Smith Co.; David W. Sowers, Sowers Manufacturing Co.; Albert F. Sulzer, Eastman Kodak Co.; William E. VanHorn, Otis Elevator Co.; Louis A. Wehle, Genesee Brewing Co.; Keith Williams, Pratt & Letchworth.

General Wesson's address on this occasion was on "The Mass Production of Armament." He said in part:

"Permit me, at this time, to render a brief progress report on this vast program. The arsenal part of the program is going along in a satisfactory manner. This is due primarily to the work which was accomplished during the years which I like to refer to as the 'golden years'—the years 1938 and 1939—when, due to increased appropriations we not only were able to reëquip our arsenals but in addition brought many designs to a state of completion and intensified our work on procurement plans. Regarding the part of the program which existing industry is undertaking, the progress also has been satisfactory. Many setbacks have been encountered due principally to lack of equipment. However, the faculty for improvising for which American industry is gifted will, in large measure, I hope, compensate for this handicap.

"Now, as to our new plant program: About two months ago, speaking before the Chicago Post of our Association, I expressed some concern about our ability to meet completion dates for these new plants, due principally to the outlook of obtaining scheduled deliveries of machine tools and plant equipment. I would be most happy tonight were it possible for me to say that this outlook has brightened. However, such is not the case; if anything, it has grown darker, due to large increases in naval and aircraft programs, the equipment for which carries higher priorities.

"Please do not misunderstand me—I am not decrying our priorities system. It is essential that we have such a system. Ordnance disappointments result from the fact that first things are placed first—and there are many first things. Since the general situation does not permit of any reduction in their number, there is but one alternative—we must speed up the effort required in producing these first things. To accomplish this result, both labor and management must give their full share. I have been in positions for many years which brought me in contact with the American workman. I think I know him well. His greatest pride is a plant operating at full capacity, turning out the best product of which he and his machine are capable. He can be depended upon to produce for the national defense in ever-increasing quantity and quality. Such delays as we have experienced in the field of labor are not a sign of unwillingness to work. I have the greatest confidence in and the highest respect for the American working man.

"By the same token, management is giving splendid evidence of its will to win in the race toward the mass production of armament. Management has coöperated in this enterprise ever since November 12, 1919. It has never once faltered in its helpful attitude toward the Ordnance Department at any time since then. During the so called 'lean years' of industrial preparedness, industry was at work planning with us as to how the job should be done in time of an emergency. It stood shoulder to shoulder with us year after year, pleading for educational orders for armament. It wanted to be informed of the job it would have to do should an emergency come.

"Now, while we foresee difficulties ahead, we are by no means discouraged. No country, despite the finest kind of industrial mobilization planning, can make the transition from commercial production to armament production without all kinds of difficulties. Let me assure you tonight that I have the greatest faith in American industry to do this job. . . .

"And the demands made necessary by the recent defense-aid legislation are constantly increasing. The Ordnance Department and private industry are prepared to handle these increases on schedule provided it is always understood that the first steps toward the mass production of armament are the longest. Balanced armament production does not come overnight nor does it come within the first half year. It has always been said, and with great truth, that a major military armament effort in the United States would require the first year for preparation and the second year to reach full production. You can figure for yourself when our greatest effectiveness in this field will begin if you reckon our first major effort from August 1940. Once we have cleared the first hurdle, augmented production becomes increasingly faster. That is a truism to you men in industry which you should not overlook when you think about the national defense. Pretty soon now the machine will begin to roll and, when it does, the mass production of armament in the United States will be the pride of every American worthy of the name despite additional demands that the newer programs are making upon our resources and facilities."

PITTSBURGH POST

THE annual meeting of the Pittsburgh Post was held at the Duquesne Club, Pittsburgh, on the evening of May 22nd. Nearly 600 members and guests, including the Railway Club of Pittsburgh, were in attendance. The presiding officer was Col. H. A. Gidney, president of the Post, and the introduction of the principal guests was made by Frank B. Bell, chief of the Pittsburgh Ordnance District. The speakers were Hon. John J. McCloy, the Assistant Secretary of War; General Wesson; E. F. Johnson, chief of the Aircraft, Ordnance, and Tools Division, Office of Production Management; and Colonel Codd.

Lieut. Col. J. L. Guion, secretary of the Post, and Maj. Thomas H. Eddy were in charge of arrangements. The meeting was the largest ever held by the Ordnance contingent in the Pittsburgh area.

Mr. Johnson's address, in part, follows:

"I am very happy to bring you a message from my chief, William S. Knudsen. Were he here he would felicitate you on the fine work that has been done and is now being done in the field of armament production under the guidance of the Pittsburgh Ordnance District. Mr. Knudsen and all of us of OPM are deeply conscious of your fine efforts now and in the years since the World War. Your planning, your interest and your energy—as in the case of the other Ordnance districts throughout

the country—have been the least costly but most valuable of any of our preparedness efforts in normal times. For that I bespeak the thanks of all of us of OPM to a man.

"But these are *not* normal times. They call for *supernormal* effort on all sides. So Mr. Knudsen's message to you is one of thanks for what you have done and are doing and one of pleading for even greater effort all down the line! Our best is not good enough these days—we must do our *ultra* best. Why? Simply because the national defense of our country demands it!

"When I went to Washington last June, just about a year ago, the first move I made was a deliberate effort to get acquainted with as many people as possible in the Army Ordnance Department, to get first-hand information on what they had been and were then doing. In a surprisingly short time I got a very definite reaction. After visiting some of the arsenals, private plants, and other points both in and out of Washington, I was most agreeably surprised by all that I saw. In fact, I was amazed, at the amount of advance work which the Ordnance Department had done in the way of research and development in design of plant surveys and allocations for production. In general, the tremendous amount of work which had been done to keep alive and expand the knowledge of how to build a defense machine was phenomenal. Every red-blooded American citizen can well be proud of it!

"We all know that for many years the general trend of thinking throughout the country has centered around the idea that war was a thing of the past, that we were forever going to live in an atmosphere of peace and good will toward all men. The word "preparedness" was practically dropped from our vocabulary. Last summer, General Wesson gave me figures which showed the really pitifully small appropriations which Congress had made for military armament during the past twenty years. These small appropriations had to cover development work, and all expenses connected with the operation of the Ordnance Department, its arsenals, depots, and district procurement organization. In every direction one looked, it seemed that everything possible was being done to discourage rather than encourage the work that was going forward so patiently. In spite of all this, the work went forward in those years. It is now going forward in the same fine spirit of service. It is being well done now.

"I do not want to burden you with a lot of figures either in actual numbers or in percentages regarding the present production flow of a great many ordnance items, but I can assure you that very substantial quantities of many important items such as shells, machine guns, powder, ammunition, rifles, etc., are already coming off the ends of the production lines. In another sixty or ninety days these numbers will be still further decidedly increased. The intense effort we have seen in Pittsburgh today is being duplicated at hundreds of points all over the country. We are now on the way!

"Without discounting the energy and 'stick-to-itiveness' of the Ordnance Department in accomplishing these results, I do not believe the Chief of Ordnance would have had the courage to carry on so well if it had not been for the coöperation, active interest, and moral support which you men of the Army Ordnance Association have supplied. I know that General Wesson, who sits here tonight, will agree with me on this.

"The job is a tremendous one, and although we can feel encouraged with the results which have been accomplished to date, we cannot be *satisfied*. Everything being done for the defense program afloat, aloft, and ashore must be multiplied many, many times. More and more speed, hard work, and yet harder work must be our watchwords.

"You men here and the many others who have made the Ordnance Association what it is today can well be proud of your handiwork. You are to be congratulated on the part you have played in building such a firm foundation for this present preparedness effort. The country as a whole is indebted to you and should be grateful for all that you have done. Without such long-continued effort, the job today would be much more difficult.

"At various times it has been pointed out that our normal condition is probably not one of peace, but rather one of preparing for or actually being at war. I sometimes feel that condition may apply for many years to come. If this is so, about all I can say is, long live a healthy and active Army Ordnance Association so that we shall always have an equally good foundation upon which to build for whatever degree of national preparedness the world of tomorrow may demand."

WASHINGTON POST

THE Washington Post continued its series of monthly luncheons at the Raleigh Hotel on the second Tuesdays of April, May and June. Col. F. H. Miles, Jr., president of the Post, presided at the meetings and on each occasion introduced the special guests who were seated with him at the head table. The average attendance at these luncheon meetings was 150.

The speaker at the April meeting was Maj. W. L. Weible who described the current organization of the Army. The speaker at the May meeting was Congressman John J. Sparkman of Alabama, who spoke on "Observations on the National Defense." The speaker at the June meeting was Robert R. Nathan of the Office of Production Management, whose topic was "Economics in Defense."

The June meeting was held on its customary day, the second Tuesday of the month, June 10th, which was also Arsenal Day. A nation-wide observance, originating in Washington and including reports from the commanding generals of the six manufacturing arsenals, was held that evening when the new Ordnance song, "Arms for the Love of America," was dedicated (see page 68). Irving Berlin, author and composer of the song, was among the honor guests at the luncheon and a special audition of the song was given for members of the Post. Colonel Miles, on behalf of the officers and directors of the Association, conferred honorary membership in the Association upon Mr. Berlin and presented him with a scroll. Later, General Wesson, acting for Brig. Gen. Benedict Crowell, president of the Association, presented the composer with the insignia of the Association, suitably inscribed. By deed of gift, Mr. Berlin has presented the copyright of the Ordnance song to the Association. As mentioned before, proceeds from its sale will be donated to Army relief and charitable purposes.

No meetings will be held in July and August, but it is the intention of the officers and directors of the chapter to resume these popular monthly luncheon meetings in September. All members of the Army Ordnance Association when visiting in Washington will be welcome at the Washington Post luncheons. They are held regularly on the second Tuesday of each month at 12:30.

THANKS

THE executive officers of the Army Ordnance Association take this means of expressing to the officials of the Posts whose activities are described above and to the other Posts which have concluded an exceptionally active season, their warmest thanks and congratulations. Each post of the Association during the past year has carried on its activities with commendable zeal. The season of 1940-1941 was remarkable in many respects but in none more than in the constructive achievements for furthering a better understanding of the current ordnance problem and the relation of American industry and the fighting services to the national defense.

NECROLOGY

NOTICE has been received of the death of the following members of the Association: Arthur P. Curtis, New Haven, Conn.; Leo Sieber, Cincinnati, Ohio; R. L. Fowler, Waterbury, Conn.; Alexander Jarecki, Erie, Pa.; Edward Mika, Philadelphia, Pa.; Morris F. Marks, St. Louis, Mo.; James A. Chiles, Jr., Charlottesville, Va.

ALL OUT FOR DEFENSE

Today defense is taking more aluminum annually than all the civilian uses in America put together ever took. During the nine-year period of 1930 to 1938, peace-time America could find use for only 14 million pounds a month from us. During the busy year of 1939, these civilian needs jumped to 27 million pounds a month. Now defense is taking almost double this amount a month, and the requirements are still going up.

To take care of this unprecedented demand, aluminum manufacturing facilities are being expanded at an unheard-of rate. Compared with the fifty some years it took the use of aluminum to reach 1939 levels, you might say that the industry is having to duplicate itself "over the week-end." It is indicative, however, of the industry's determination to meet the needs of the National Defense Program. Aluminum Company of America, 2137 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

Ordnance in Review

An Industrial Armory

By Lieut. Col. Calvin Goddard, Ord. Res.

To the man in the street the modern factory constitutes a ravenous maw which engulfs daily thousands of his fellows to transmute them, for eight hours of the twenty-four, into stereotyped automatons devoid of sense or feeling—performing intuitively some single mechanical operation requiring but a modicum of intelligence and no appreciation of the æsthetic. And the twentieth-century urge toward mass production in the United

John Woodman Higgins Armory, Worcester, Mass.

States has no doubt lent much substance to such an opinion. Happily, however, there lives today at least one industrialist who believes that efficiency and beauty, both of design and execution, are not mutually exclusive. This gentleman is John Woodman Higgins, president of the Worcester Pressed Steel Corporation, and founder of the museum and armory which bears his name.

In a number of short monographs, Mr. Higgins has expressed his views with such skill and logic as to leave one convinced that the case for beauty in the mass products of our modern machines, rather than being closed, has scarce been argued at all. He hints, and with reason, that its advocates are only now becoming articulate and that when their combined voices are finally heard, those who today argue that what is utilitarian must of necessity be *ugly* will be forced to hoist the white flag. Perhaps we can best illustrate his viewpoint by quoting from an article which he contributed to *Iron Age* in August 1937. He says:

"Manufacturers must be realists and devote their first attention to techniques, mechanics, and functional engineering, but their products should express a correlation between efficiency of function and harmony of proportion that is deeper than sur-

face beauty. As inventors and engineers keep on improving machines and machine products, the day will come when every home will be fully furnished with art masterpieces of mass production, expressing beauty, efficiency, culture, and happiness. The reason manufacturers do not now make all quality products beautiful works of art is because the public does not demand them, not because they cannot be made. Machine parts, while designed by mechanical engineers for efficiency of production as well as for service, must be art modeled to express appropriate beauty in the finished composition. Ugliness . . . is an offense against civilization."

BUT Mr. Higgins is not alone an apostle of beauty. There are other important fields in which he is prepared to do battle. Notable is his insistence upon the duty of society to afford the adolescent the opportunity to learn how to work with his *hands* as well as his head. To make his point, he furnishes some startling statistics (*Industrial Education*, March 1937): "For vocational-training courses, America is now allotting only one per cent of her three thousand million taxpayers' dollars expended annually for public education. [Emergency conditions arising since 1937 have, of course, increased this percentage materially.—Author.] Ninety-nine per cent is devoted to general preparation for other professions, many of them overcrowded and likely to remain so for years. Out of every one hundred pupils, ninety-eight are receiving no school training directed toward trade employment, and we know that the boys will never find happiness in life until they discover that they possess talents that the world wants sufficiently to pay for."

Mr. Higgins has yet another story to tell—the story of steel, for the fabrication of steel products is his vocation. To it he applies all the agencies which modern science has placed at his command. Thanks to these he is able to produce objects of the highest utility. But this is not enough, they must be beautiful as well. And so he has made a study of art as applied to the metal-working industry from its most remote beginnings to the present day. Some of the observations to which this has led him appear rather startling. Thus we learn (*Industrial Education*, March 1939) that "unknown stone-age nomadic artists first made beautiful things and then adapted them to useful purposes . . . Archæologists and sociologists conclude that man naturally creates art and beauty without regard to his material comforts and social progress, but that industry is the factor which determines his standard of living. Art expresses no affinity for industry, *but industry develops a strong affinity for art*" (Italics ours).

More than eleven years ago, Mr. Higgins decided that he could best convey to others his ideas on art in industry, manual training, and on the manner in which the two can be made to work together toward the production of metal wares which combine beauty and utility, by establishing an industrial museum or armory in which would be exhibited specimens of fabricated iron and steel from the beginning of mankind's acquaintance with the ferrous metals. The armory building which forms a unit of the plant of the Worcester Pressed Steel Company was the result. Divided into two wings, the curious visitors (who arrive in numbers averaging 10,000 annually) find in one, specimens of the most modern machine-pressed products and in the other, examples of the crude implements of their ancestors as fabricated over the 2,000 years which have elapsed since steel was first refined, not to mention tools and weapons of earlier times from the stone age onward.

OUTSTANDING among the exhibits here presented is a collection of medieval armor of all types, from the most utilitarian worn by the humble foot soldier, to the most ornate designed for festal wear by some reigning prince. Here is found the handiwork of many of the most famous armorers of the Middle Ages and the Renaissance and some of the most effective and ornate examples of their art.

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OF ALL TYPES

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A study of the items on display reveals the fact that chain mail preceded armor of the plate type and was the exclusive defensive equipment of the Crusader. Made of interlocking rings of hand-hammered wire, its fabrication required the highest skill and patience. That this was produced in no small quantities, is evidenced by the fact that in a single battle of the thirteenth century, no less than 6,000 horses wore blankets of chain mail. But it afforded protection from cutting weapons alone. Against the effects of thrusting or crushing instruments it was valueless. As a result, armorers began to affix steel plates over mail at the most vulnerable points. These caused cutting and thrusting weapons to glance off harmlessly, and cushioned the effects of those of the crushing type.

But as has ever been the case, offensive agencies increased constantly in power and it became necessary steadily to strengthen the armor. The easiest way to accomplish this was by extending the area reënforced with plate. Thus, by about 1400, the full suit of plate armor had evolved.

The zenith of plate armor was reached shortly prior to the middle of the sixteenth century. Weight was reduced by the device of fluting the plates, and strength was increased by corrugating the sheet metal. Thereafter a period of decadence set in, sturdiness giving way to intricate design and ornate embellishment which extended even to the point of gilt inlays and jeweled incrustations. In addition, the steady improvement in firearms was having its effect. To be bullet-proof, armor had to be increased so materially in weight that it finally became unbearable both to man and beast. Subsequent to 1600, the effort to accomplish weight reduction resulted in the adoption of suits of three-quarter size; later even half suits became popular. Around 1700 the unequal struggle ended, and armor was entirely discarded save for jousting purposes, not to be seriously resumed until the advent of the first World War.

While these exhibits of medieval armor form perhaps the rarest and most impressive of the exhibits in the armory, they by no means exhaust the list. Racks of edged weapons—knives, sabers, and bayonets of all periods—are prominently displayed, as are others filled with firearms of every age since the invention of gunpowder, with a small fieldpiece or two to catch the eye of the artillerist. Intrigued by this array of past achievements in metal fabrication, the average visitor is prompted to avail himself of the opportunity, open to all, of witnessing in the adjoining mill and factory the cold rolling and press forming of the ferrous products of today.

The purpose of the museum, as stated in *American Business* (March 1940) is: "To inspire steel workers, to attract superior employees, to stimulate greater art in industry, to improve steel craftsmanship, to inform the public regarding the history of pressed-steel products, and to preserve the best examples of steel craftsmanship for future generations."

These may be but the idle dreams of a visionary. But they bring to mind the dreams of another industrial "visionary" which, over eighty years ago, caused men to mutter darkly as he passed and tap their heads significantly. For he believed in, and practiced, a 10-hour workday as against the conventional span of twelve or thirteen hours. He had queer ideas about recreational facilities for his employees and decent living quarters for them. He violated tradition by giving them washrooms where they could remove the grime when the day was ended. And, finally, he confirmed beyond all doubt the diagnosis of lunacy when he established *pensions*, if you please, for those grown old in his service. His name was Samuel Colt.

The index to Volume XXI of ARMY ORDNANCE, *with title page for binding is now ready. Arranged alphabetically by subject and author, the index covers the July-August 1940 issue to the May-June 1941 issue inclusive. Copies may be obtained on request.*

Ordnance Reserve

DEFERMENT FROM ACTIVE DUTY

WHERE 1941 R.O.T.C. graduates who are commissioned in the Officers' Reserve Corps could contribute more to the national defense by employment in essential industry than by active duty at this time, deferment from such active duty may be granted by corps-area commanders, it has been pointed out by the War Department. What constitutes essential industry and the period of deferment is left to the judgment of the corps-area commander.

Corps-area commanders must be the judge as to what deferments are to be granted. In this connection, attention is invited to the fact that deferment of a Reserve officer in a key position is a deferment only; that the deferment is made in order to permit the industry to train another individual to fill the key position; and that when the corps-area cannot meet its requirements unless that Reserve officer be called to duty, he will, with due notice, be called.

RESERVE OFFICER PROMOTIONS

ALL Reserve officers who, before May 1, 1941, met all requirements prescribed by Army regulations for promotion but who were not promoted because vacancies in their particular branch did not exist, will be offered promotions under authority granted recently. A survey has shown that only 1,424 or less than 1.25 per cent of the active Reserve officers are eligible for promotions under this authority.

In order to protect those now on active duty who may find a lack of appropriate assignment if they accept promotion, and those not yet on duty who believe their promotion will jeopardize chances of being called to active duty, the promotion may be refused without sacrificing rights to the promotion at a future date. Previous limitations on promotions were set by the Peacetime Procurement Objective. A new objective now is under study by the War Department.

REAPPOINTMENT OF RESERVE OFFICERS

FORMER Reserve officers of junior grades who, for business or other reasons, were forced to relinquish their commissions, may be reappointed as second lieutenants provided that:

(1) Original appointment as a Reserve officer was made subsequent to 1933; (2) They were in an eligible status at the time their Reserve appointment was terminated; (3) Their appointments were not terminated for misconduct or similar cause; (4) They pass a final-type physical examination; (5) They have the approval of the corps-area or department commander or chief of branch concerned; (6) They attain a new certificate of capacity.

The War Department is taking this action in order to utilize the services of the younger former Reserve officers who for the most part have received four years of training at Government expense in the R.O.T.C. units with the various colleges. Many of them for business or family reasons have felt obligated to permit their Reserve appointments to lapse but with the emergency now confronting the country desire to offer their services in their former capacities.

It is contemplated that former Reserve officers who are reappointed under this policy will be ordered to extended active duty for one year at such time as their services are required, and they must be willing to accept active duty at any time.

The certificate of capacity will require a refresher course in subjects with which they were formerly familiar prior to ap-

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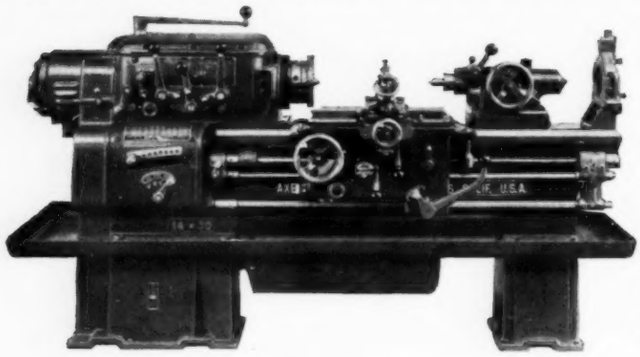

Engineering skill and extreme care in the selection of raw materials are wasted unless they are accompanied by equal skill and painstaking effort in manufacture. Axelson Lathes are designed right and they are built throughout of materials best adapted to the purpose. On this basic foundation Axelson craftsmen construct a machine tool precise in every operation and finished in every detail. Press the starting button upon an Axelson Lathe—listen to its smooth, quiet action. Place a job between centers, adjust the cutting tool and note how free from vibration it is at any speed and with varying cuts. Remember, Axelson Lathes afford a wide range of operating speeds and feeds necessary for fast production.

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pointment. For the Field Artillery, for example, the attainment of the certificate of capacity will require completion of extension-course work in the following subjects:

Organization of the Army; organization of the Field Artillery; administration (1); military law—the law of military offenses; military discipline, courtesies, and customs of the service; interior guard duty; map and aërial photograph reading; military sanitation and first aid; division artillery matériel and ammunition; firing battery.

In announcing this policy, the War Department stressed the point that an effort was being made to salvage competent officer material formerly trained at Government expense.

Officer Identification Cards

As a means of positive identification for every officer of the Army of the United States, work has begun on preparation of cards containing photographs, fingerprints, signatures, and personal details about each officer. Corps-area and department commanders will be responsible for carrying out details of the project. Every officer on active duty, whether Regular Army, National Guard, or Reserve, will receive one of the cards. As additional Reserve or National Guard officers go on duty, they will be issued the identification cards.

The full size of the card, which has a flexible brown back, is 4 by 7½ inches, and it folds to a convenient size for carrying in the ordinary billfold. Photographic equipment for taking pictures of the proper size already has been sent to all corps areas and departments. The cards will contain each officer's name, grade, arm or service, serial number, date of birth, color of eyes and hair, weight and height. Fingerprints of all fingers of the right hand also will be placed on the cards. The finder of a lost card may return it to The Adjutant General post-free, as the proper address and franking privilege is printed on the card. At present, there are approximately 80,500 officers on active duty in the Army of the United States who will be included in this project.

Enlisted Reserve Corps

Provisions have been made for the enlistment in the Enlisted Reserve Corps of certain former enlisted men of the Regular Army who are within the Selective Service age limits, providing they have more than two years' Army service. This action modifies a previous ruling which suspended enlistments or reënlistments in the Enlisted Reserve Corps, except when specifically directed by the War Department.

Under the new ruling, former Regular Army enlisted men who have had more than two years' service in any one enlistment and who have been discharged for the convenience of the Government, or by purchase, or for dependency, may be enlisted in the Enlisted Reserve Corps if they are qualified otherwise under existing Army Regulations.

Discharges before the term of a 3-year enlistment is up have been given for the convenience of the Government in many cases to enlisted men returning from foreign service who have insufficient time remaining in their enlistment to warrant assignment to a new station.

The action was taken because it was considered that all former Regular Army enlisted men with two years' or more of service had received the desired training and were qualified without reservation for the Enlisted Reserve Corps. It was felt that requiring such individuals to reënter the Army through provisions of the Selective Training and Service Act was unfair to the individual and not the intent of the act.

The Director of Selective Service has been requested to notify all local boards that men who meet the above requirements are eligible for enlistment in the Enlisted Reserve Corps, and therefore will not be required to register.

ORDNANCE TRAINING CENTER

THE Ordnance Training Center at Aberdeen Proving Ground, Md., is going in heavily for athletics with the hearty encouragement of Capt. Norman W. Smith, chief morale and recreation officer. The center entered a team in the recent Penn Relays at Philadelphia made up of Lieuts. Glenn Funk and Standley Haight, both of whom ran on the track team of the University of Nebraska; Lieut. Chester Ross, a member of last year's Massachusetts Institute of Technology track team, and Roland Maione, a member of the 40th Ordnance Company, who runs an exceptionally fast quarter. In addition to track, a league of eight soft-ball teams has been organized on the post, a team of officers has been entered in the Harford County (Md.) soft-ball league, and other activities under way include boxing, badminton, baseball, volley ball, high ball, and lacrosse. Captain Smith, formerly was athletic director at Wyoming Seminary, Kingston, Pa. He is being assisted by Lieuts. Francis P. Harrison, former coach at Woodberry Forest School, Orange, Va.; Bruce E. Ferguson, former coach at Western Maryland University, and L. B. Barth, former coach in Philadelphia high schools. The first of 4 new theaters, containing 322 upholstered seats, has been completed at the Ordnance Training Center. Among those present at the opening were Col. Julian S. Hatcher, commanding officer of the Training Center, and his staff, and Lieut. Col. George W. Outland, under whose direction the theater was built and equipped.

ARMORED ENGLISH

THE following are some of the recent slang expressions coined by personnel of the Armored Force:

Slang	*Translation*
Jeep	Command car
Peep (son of a jeep)	Bantam car
Gravel agitator	Infantryman
Hell buggy	Tank
Rat race	Mounted review
Popsickle	Motorcycle
Button up	To close tank
Barracks 13	Guardhouse
Hash mark	Service stripe
Doodle bug	Tank
To herd	Drive
Scatter gun	Machine gun
Tub	Scout car
Turn 'em over	Start engines
Dit da artist	Radio operator
Gasoline cowboy	Member of Armored Force
Crossbar Hotel	Guardhouse
G. I. (Government issue) war	Maneuver
Sky winder	Air Corps man
Homing device	A pass or furlough
Little poison	37-mm. gun
Iron horses	Tanks
Pour on the coal	Give it the throttle
Flying the iron beam	Pilot flying along a railroad
Flying the wet beam	Pilot flying along a river
Jumping jeep	Autogiro with jump take-off
Hit the silk	Use a parachute
Static bender	Radio operator
Button chopper	The laundry
Cockpit fog	Mentally lost
Bend the throttle	To fly above normal cruising speed
Self-commencer	Engine hand crank
Persuader	Inertia starter switch
Knuckle buster	Crescent wrench
Comb it	Detailed inspection of tank
Tear 'em out	Clash gears

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NATIONAL Seamless is available in sizes ranging from 3/16-inch mechanical tubing to 24-inch O.D. pipe, and in wall thicknesses to meet practically any requirement. Various grades of steels, from plain carbon to the high-alloy grades, can be supplied.

The seamless process is particularly adapted to the production of heavy walled tubing, various types of cylinders, and tubular forgings in a wide range, especially where upsetting, swaging, spinning, or bending operations are to be performed and where a clean, smooth bore or surface finish is highly important. Either as NATIONAL Seamless Pipe or as Shelby Seamless Mechanical Tubing, the identifying emblem, "Walls Without Welds," means—America's Preferred Pipe and Tubes.

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UNITED STATES STEEL

From the Record

The following quotations are from addresses or writings of recognized authorities and comprise a cross section of opinion on subjects closely allied to the national defense. They have been selected for publication as being important and timely. ARMY ORDNANCE *thus hopes to acquaint readers with qualified views regarding various phases of industrial preparedness.*

THE PROCUREMENT OF ORDNANCE

COMPARISON of the speed with which our procurement program was instituted in 1940 with similar efforts in 1917 is convenient only to measure our rate of progress with our accomplishments of twenty-three years ago, but it may be of interest if only for that purpose. Let us consider first certain ordnance items:

By the close of the last war, we were able to supply our Army in France from sources in this country with rifles, bayonets, cartridges, and some other light equipment. All heavier equipment with which our soldiers fought was supplied by the French and the British. Our Army, as has been said, did its fighting with artillery purchased from France. We ordered over ten thousand 75-mm. guns to be produced in this country, but none were finished in 1917, and in 1918 we only succeeded in shipping 143 to France before the Armistice was signed.

In the last war, in spite of the American familiarity with tractor machinery and in spite of the fact that we ordered over 23,000 tanks to be produced in this country, not a single one of those tanks was finished in time for training purposes at home or for combat use overseas. Today, our production of tanks is already well under way and in quantity production in spite of the fact that the present-day tank is a far more complicated and intricate piece of mechanism than was the tank of the last war.

We have many old-type machine guns on hand from the last war. Our production of these weapons is one of which we can be proud, but the demands for improved types of these weapons are great and exacting. With the need for heavier calibers and more intricate designs arising from aircraft, antiaircraft, tank, and antitank requirements, the problem of machine-gun design and manufacture has become much more complicated and difficult. But here again, the Department was able to institute the program, select the types and the manufacturers, and place the orders practically as soon as the money was made available by Congress.

We have an entirely new line of artillery and mortars all involving new designs. These weapons have much greater mobility, range, and, in many cases, fire power than their World War counterparts. In all these items we are far ahead of our 1917 schedules. Highly complicated antiaircraft guns—guns which are clocklike in their intricacy and which fire heavy-caliber projectiles at phenomenal rates of speed—have been developed and are now in production. In the World War, only one gun especially designed for antiaircraft fire was completely finished in this country by the time of the Armistice.

Before 1940, the War Department had anticipated the need for the new artillery types, but it was not until September 1940 that money was available in sufficient quantity to enable the Ordnance Department to institute an adequate artillery program.

The development of actual warfare culminating in the breakthrough in Flanders necessitated some rapid modification of types, but it is a tribute to the planning of the War Department that the designs required so little change after the reports of the performance of the various weapons began to come in from our observers. In ordnance items, the chief modifications which

actual warfare induced were in the design of tanks. The new designs were promptly put in production, however, and, as a result, all our equipment now in production is thoroughly modern.

One aspect of the Ordnance program, which is present as a retarding factor in 1940 and which was not present in 1917, results from the competition which ordnance manufacturers must encounter with the aircraft suppliers for machine tools. With the metalization of airplanes and airplane parts and with the greatly increased emphasis on the importance of aircraft generally, it has been found that conflicting demands for machine tools have arisen, and all ordnance items, except aircraft armament, have been sharply subordinated in their priority to aircraft needs as well as to the needs of the Navy. But in spite of these delays, unless the priorities of ordnance items are further modified, the Ordnance program should proceed in accordance with the above outlines; *i.e.*, with quantity production averaging about one year to fourteen months after placement of the order.—*Hon. Henry L. Stimson, Secretary of War.*

THE GERMAN ARMY

WE do not minimize the tremendous power of armored units used in conjunction with accompanying air power. Together they deliver a blow that tears open the enemy's line and disorganizes his rear elements and installations, but the armored force moves swiftly and it must be followed by troops that will stick to the ground and hold it. Through the break created by armored units the infantry-artillery teams pour through, pinning down or destroying the enemy that will try to close the gap. . . .

Germany has approximately 260 divisions, of which about 20 are mechanized. These mechanized units are the striking force. They plunge into the enemy's line and blast a way for the infantry and artillery which exploit the initial success of the armored force. At Sedan, 10 armored divisions cracked the French line. Behind them was a mass of 100 infantry divisions—1,600,000 men on foot—which marched through behind the tanks. Not all of them had to fight, but they pressed against the surging enemy lines formed on both sides of the gap to Dunkerque and held on. Recently there was placed on my desk a translation from one of the most important German military magazines. The author, a colonel in the German Army, writing on the subject of infantry in the *Blitzkrieg*, gives the following excellent picture of German organization:

"The catchwords '*Blitzkrieg*' and 'new tactics,' generally adopted abroad and which we, too, have quickly accepted, seem to have given rise to a wholly false conception in the minds of many people. It is time to analyze these terms in order that the valuable experiences gained in previous wars may not be lost, that we may be guided by new experiences gained in the present war, and that the victories won by an ingenious command and well-trained troops may not be minimized through the belief in a miracle. Foreign commentators, by applying such catchwords, have tried to imply, in order to conceal their own military failures, that we were using some secret force. . . . Great importance is attached to the infantry in our army with full knowledge of the principle on which the good old German military ideal is based; namely, that the courage and efficiency of the individual soldier is the decisive factor, regardless of the technique employed. The infantry constitutes the main arm and is supported by all the other arms which try to see to it, as far as possible, that the infantry is able to engage in close combat against the enemy with its strength impaired as little as possible. If our aviators and tanks have succeeded during the present war in utilizing this tactical principle to such good advantage in many places that the infantry has often encountered an already crushed foe, this merely proves that our troops of all arms have been properly trained and not that the importance of the infantry's missions has diminished."—*Gen. George C. Marshall, Chief of Staff, U. S. Army.*

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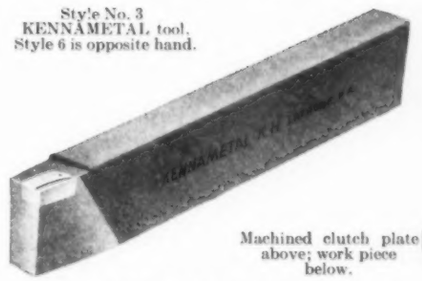
Style No. 3 KENNAMETAL tool. Style 6 is opposite hand.



Machined clutch plate above; work piece below.

Two standard KENNAMETAL tools, Styles 6T50 and 3T50, were used on opposite sides of the work in facing these clutch plates for tanks. Due to the thin sections being machined, the parts will have a tendency to "chatter" and spoil the tool edge, unless the tools wear uniformly. The two KENNAMETAL tools wore so evenly that there was no sign of "weaving" or "chattering" when the clutch plates were machined. KENNAMETAL cut these hard steel parts evenly and smoothly with no galling or "cratering" on the tip.

Details of this job are as follows:

Material	S.A.E. 1095, H. T.
Brinell	240-270.
R.P.M. of Work	66
Cut Feet per minute	260
Depth of cut, each tool	.120"
Feed per revolution, each tool	.017"
Pieces per grind per set of tools	25 to 35

KENNAMETAL is proving outstandingly successful in machining parts for tanks, airplanes, guns, etc., where *hard* steel is so frequently used. KENNAMETAL machines steel of all hardnesses up to 550 Brinell at economical high speeds, with minimum tool wear, and without "cratering." If you are responsible for speeding up production of armaments and ordnance, investigate KENNAMETAL—today.

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Book Reviews

AN ENGINEER'S MANUAL OF STATISTICAL METHODS. By Leslie E. Simon. New York: John Wiley & Sons. 1941. $2.75.

IT is a very sweeping statement to make, but nevertheless true, that methods pursued quite generally in the Ordnance Department and in industry for testing the quality of manufactured items have been most inadequate. For example, suppose we require that ninety per cent of a certain lot of fuzes must function satisfactorily. The general method of determining this quality has been to fire ten fuzes selected at random and require that not more than one shall fail. Strange as it may seem, the result is that a large percentage of defective fuzes may be accepted under this scheme and a considerable percentage of acceptable fuzes may be rejected. Major Simon in this timely book explains this phenomenon very clearly and describes in detail how to avoid such a situation.

Nearly ten years ago, Major Simon saw the necessity for getting to the bottom of the subject of specifications and acceptance testing. He was at Picatinny Arsenal where ammunition is manufactured and saw that the only positive tests of ammunition that can be made are destructive; that is, the ammunition must be fired to prove its quality. Obviously, this is expensive, so that it is of great importance to be sure of quality at a minimum cost.

The methods outlined in his manual are by no means restricted to ammunition or even to ordnance but have a wide application throughout industry. The methods are not new and have been in use for some years in this country and abroad in the sampling and testing of coal, in the textile industry, electrical industry, and many other fields. However, Major Simon has made some definite contributions to the subject and shows that the men who apply the methods do not require a mathematical education but merely a knowledge of what he terms "corner-grocery-store arithmetic." Obviously, a plant installing a system of quality control does require an engineer who has become conversant with the subject to establish the system and to handle unexpected developments.

Major Simon deserves particular credit because of his simplification of the problem and his very clear presentation. Furthermore, in these busy times for the Army, he must have burned a great deal of midnight oil.

The reviewer feels that if all industrial executives will read only chapter one of this book, they will be completely sold on the methods presented in the remaining pages. In addition to seeing the fallaciousness of their own specifications, these executives should be impressed with the fact that the use of these methods will warn them *in advance* of defective production.

Of special note are the chapters on sample size, specifications, and how to set up a quality-control system. This book merits study by all supply services of the Army. Also noteworthy is the chapter which deals with significant differences. This is new and will be of inestimable value to engineers in interpreting the results of tests. Finally, in the back of the book are a number of charts which will save the engineer a great deal of time in computing probabilities such as are required in quality control work.

A. B. JOHNSON.

AIR RAID PRECAUTIONS. Reprinted by permission of the Controller of His Britannic Majesty's Stationery Office. Brooklyn: Chemical Publishing Company, Inc. $3.

THIS is the first American edition of the official British regulations for air-raid precautions. It is divided into ten parts, the titles of which are themselves explanatory. They are: Rescue

parties and clearance of debris, organization of decontamination services, organization of air-raid wardens' service, structural defense, local communications and reporting of air-raid damage, notes on training and exercises, gas detection and identification service, protection of windows in commercial and industrial buildings, inspection and repair of respirators and oilskin clothing, care and custody of equipment.

No more timely book has appeared among the many which American publishers are now so helpfully presenting on various phases of our national defense. It may seem a far cry for the average American citizen to stress the need for information as to aid-raid precautions. Especially does this seem true when one considers the apparent conviction of our people that it can't happen here. It is not the purpose of this book or of this review to argue the point about the necessity. This volume describes an objective condition; this review proposes that this condition be known and understood by all.

The reviewer is not in a position to differ with any of the statements made in this book, for, like most of his American fellows, he has not had actual experience in air raids. However, what is here written can be taken as good examples of procedures, techniques, and principles to be followed.

Civil populations, even more than military forces, are being put to the test these days by indiscriminate air raids. The first and most important precaution is that of morale which will come only from a basic determination to win. But equally necessary is factual knowledge of what to do and what not to do in an air raid. The British Government and the publishers have rendered Americans a distinct service by making available at this time in easily readable form the precautions that civilized people ought to know about if they are to survive the most unmoral type of warfare in the pages of history; that is, the indiscriminate attack upon civil populations. L. A. CODD.

COAST ARTILLERY. A Complete Manual of Technique and Matériel. Harrisburg: The Military Service Publishing Company.

THIS is a book of more than a thousand pages comprising four volumes devoted to training, organization, tactics, and technique of the United States Coast Artillery. Volumes 1 and 2 are the basic manual; volumes 3 and 4 are the advanced. The four volumes are bound as one.

The basic text describes the organization of the Coast Artillery, the weapons, matériel, and ammunition it uses. The advanced text treats of such intricate problems as fire control and position firing for both seacoast and antiaircraft artillery and the tactics and technique of both classes.

The text is the same as the official manuals on the subject but has the advantage of being available in compact form so that it will fill the needs not only of the soldier and officer on active duty but equally well of those civilians who are directly or indirectly concerned with the subject. In this latter regard, the book should be of particular value to engineers and manufacturers at present engaged in production as it will acquaint them with the uses and purposes of the weapons now being built. R. E. LEWIS, JR.

LITTLE MAC—THE LIFE OF GEN. GEORGE B. MCCLELLAN. By Clarence Edward Macartney. Philadelphia: Dorrance & Co.

IN an era of *Blitzkrieg*, there is little for the modern soldier to learn from the campaigns of a master of "sitzkrieg." Nevertheless, this life of McClellan, which is almost exclusively confined to his activities during the Civil War, makes profitable reading. It throws little new light on the General's military career, but it offers a rich field for the study of the relations between military and political chiefs.

The lack of confidence between Lincoln and McClellan was undeniably a primary reason for the failure of the Peninsular Cam-

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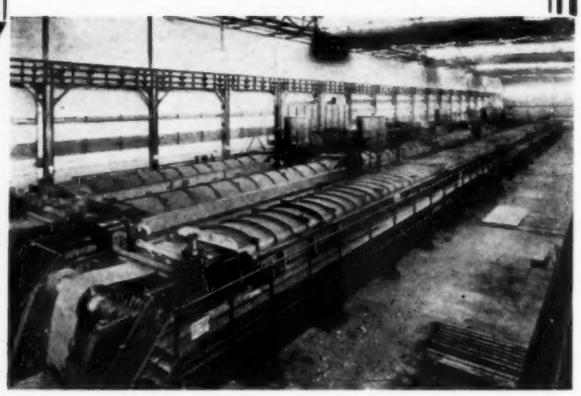

Photograph: Courtesy of Atlas Mineral Products Company and B. F. Goodrich Company.

Thousands of miles of sheet steel roll out of our mills—sheets unavoidably covered with scale. To make surfaces bright and clean these are "pickled" and the liquid that does the trick is that old standby —sulphuric acid—of which about 980,000 tons were consumed by the American steel industry last year.

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paign. Although McClellan's intellect was equal to the task of organizing and training an army and probably of devising a successful war plan, he was not endowed with the capacity for cooperation with the civil government. In a soldier, character is as important as intellect. A leader with a greater degree of loyalty and respect for his civilian chiefs might have conducted the campaign with better chances of success, in spite of unfortunate civilian interference. Mr. Macartney describes the relations of a soldier and statesman in a way that merits careful study. The politician is ever with us, and always will be in our democracy. This example of the most depressing results of an unsatisfactory relationship between a soldier and his government is a salutary study for all in authority.

Those who are harassed in this critical period by innumerable inventors with devices to revolutionize warfare would welcome the solution adopted in one particular case in the Civil War. The anecdote deserves to be quoted in full:

> "When Gen. D. H. Butterfield was Hooker's Chief of Staff, Lincoln turned over to him a gaunt, haggard individual who had been haunting him for days with a request to display a new and terrible weapon of destruction. This individual appeared at Butterfield's headquarters carrying a huge case, nine feet long. Opening the case, he brought out an enormous knife, looking like a scythe. He explained to Butterfield that the knife was to be fastened to the saddle of a horse. In a cavalry charge, the formidable-looking blade would release itself and, sweeping around in a circle, would cut off every head within range. Butterfield inquired about the head of the horse and, being assured by the inventor that neither horse nor rider would suffer from the revolutions of the dreadful blade, informed him that on the morrow the cavalry was going to make an attack on the enemy's outpost and invited him to attach his weapon to one of the cavalry horses and join in the charge. If the weapon proved to be successful, Butterfield promised to recommend it to the War Department. The inventor did not show up."

Can anyone devise a better method of getting rid of importunate inventors? DONALD ARMSTRONG.

MASTERING THE RIFLE. By Morris Fisher. New York: G. P. Putnam's Sons. $2.50.

THE Marine Corps has missed Sergeant Major Fisher since he retired. The Quantico rifle range has not been quite the same without his familiar figure and expert coaching, which your reviewer personally enjoyed last in June 1933.

The author once won an Olympic match with a regulation Springfield rifle! Yes, he can shoot; but unlike so many who are proficient in their field he also can impart his knowledge, as he has done with rare ability in this introductory study of shooting technique, primarily for tyros, but not to be ignored by experts who have mastered the rifle.

The following passage is illustrative of common-sense coaching: "The more comfortable you are, the better your scores will be." The author questions the use of sling strap—thus pleasing the reviewer—advocates a full rather than a six o'clock sight—which the reviewer, alas, must question, but mildly—advocates both eyes open if possible—an excellent point. "It's not the top score which wins a team match; it's the low score that loses it." MELVIN M. JOHNSON, JR.

GENERALS AND GENERALSHIP. By Gen. Sir Archibald Wavell. New York: The Macmillan Company. $.50.

A LITTLE book of thirty-six pages comprising the Lees Knowles Lectures delivered in 1939 at Trinity College, Cambridge, by the distinguished officer now commanding the British Armies in the Near East. Given a fraction of the support so clear a thinker deserves—and far less inane political nonsense—the British Armies cannot fail in their present task. L. A. CODD.